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(54) **Oscillating air dispensers for oven, in particular for microwave oven**

Oszillierender Luftspender für Ofen, insbesondere für Mikrowellenofen

Distributeurs d'air oscillants pour fours, en particulier pour fours à micro-ondes

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Description

The invention relates to recirculating air convection ovens for heating food products.

In heavy duty foodservice ovens and food vending machines, cleaning is a major consideration. This is particularly important in air recirculating impingement ovens of the type disclosed in U.S. Patent No. 3,884,213 and in convection ovens with microwave food heating.

Patent No. 3,884,213 discloses an oven equipped with a pivotally mounted, rectangular shaped, microwave transparent plate having spaced tubes extending therethrough for forming collimated jets of air that are projected to impinge upon surfaces of a food product. While the disclosed oven provided significant improvements in the transfer of heat to the food product, it was difficult to clean and maintain. Further, the shape and mounting for the jet plate did not permit optimum air flow to provide maximum efficiency and required that the jet plate be microwave transparent.

Vending machines for dispensing hot and cold drinks, candy, cookies, potato chips and other snack foods have enjoyed significant commercial success. However, vending machines for dispensing meals have been limited to dispensers of refrigerated foods such as sandwiches, salads and the like.

Devices heretofore devised for incorporating electronic ovens in food vending machines are disclosed in U.S. Patent No. 3,333,666; U.S. Patent No. 3,343,479; U.S. Patent No. 3,386,550; U.S. Patent No. 3,397,817; U.S. Patent No. 3,534,676; U.S. Patent No. 4,004,712; U.S. Patent No. 4,398,651; U.S. Patent No. 4,592,485; U.S. Patent No. 4,762,250; U.S. Patent No. 4,783,582 and U.S. Patent No. 4,784,292.

Vending machines for hot meals generally include a refrigerated compartment for preserving food, a microwave oven compartment for fast cooking, and a conveyor for transferring food from the refrigerated compartment into the microwave oven. However, since vending machines for hot foods have enjoyed very limited commercial success, separate microwave ovens for heating food items removed from a refrigerator are commonly employed in convenience stores, airports, cafeterias and other food vending operations.

Microwave heating of certain foods, including pizza and sandwiches that contain dough and bakery products, typically leaves the surface too moist and less palatable than similar food products cooked in other types of ovens.

Ovens of the type disclosed in U.S. Patent No. 3,884,213; U.S. Patent No. 4,154,861; U.S. Patent No. 4,289,792; U.S. Patent No. 4,409,453 and U.S. Patent No. 4,835,351 employ air jets which impinge upon the surface of a food product to provide surface heating of the product in combination with microwave heating. Jet impingement ovens have enjoyed significant success in commercial food service and commercial food processing operations. However, a long felt need exists for apparatus for quickly and efficiently heating food products that require little or no preparation for use in a vending machine for hot meals and in counter top ovens for foodservice operations that are easily cleaned.

These and other objects forming the basis of the present invention are obtained with the method according to claim 1 and the apparatuses according to claims 8 and 22. Advantageous embodiments of the invention are claimed in the dependent claims.

Drawings of a preferred embodiment of the microwave vending machine are annexed hereto so that the invention may be better and more fully understood, in which:

FIG. 1 is a perspective view of a package handling apparatus and oven cabinet inside a vending machine, the outer cabinet of the vending machine being broken away to more clearly illustrate details of construction;

FIG. 2 is a cross-sectional view taken along line 2-2 of FIG. 1;

FIG. 3 is a cross-sectional view taken along line 3-3 of FIG. 2;

FIG. 4 is an exploded perspective view of the air dispensing apparatus;

FIG. 5 is a cross-sectional view taken along line 5-5 of FIG. 1;

FIG. 6 is a cross-sectional view taken along line 6-6 of FIG. 1;

FIG. 7 is an exploded perspective view of a container and protective sleeve that form a package for a food product;

FIG. 8 is an elevational view of the package illustrated in FIG. 7, parts being broken away to more clearly illustrated details of construction;

FIG. 9 is a fragmentary diagrammatic view illustrating a modified form of a food container having susceptor film mounted therein;

FIG. 10 is a fragmentary diagrammatic view of a food container having a bottom layer of french fried food material and an upper layer of a different food product;

FIG. 11 is a diagrammatic view illustrating air flow during a first stage of the cooking process; and

FIG. 12 is a diagrammatic view similar to FIG. 11 illustrating air flow during a second stage of the cooking process;

FIG. 13 is a perspective view of the external vending machine cabinet;

FIG. 14 is a cross sectional view taken through the electro-mechanical linear actuator;

FIG. 15 is a diagrammatic view similar to FIG. 11 illustrating air flow through a particulate food product;

FIG. 16 is a perspective view of a container having a lattice bridging the open top thereof;

FIG. 17 is a perspective view of the bottom of the container illustrated in FIG. 16;

FIG. 18 is a cross-sectional view taken along line 18-18 of FIG. 16;
FIGS. 19-21 are cross-sectional views similar to FIG. 18 diagrammatically illustrating the progressive heating of a film sealing the container to uncover a food product in the container;
FIG. 22 is a top plan view of a second embodiment of the oven, parts being broken away to more clearly illustrate details of construction;
FIG. 23 is a cross-sectional view taken along line 23-23 of FIG. 22;
FIG. 24 is a cross-sectional view taken along line 24-24 of FIG. 22;
FIG. 25 is a cross-sectional view taken along line 25-25 of FIG. 22;
FIG. 26 is a fragmentary perspective view of a pair of oscillating air dispensing ducts;
FIG. 27 is a fragmentary elevational view of a portion of the partition between the cooking chamber and the air conditioning chamber;
FIG. 28 is a cross-sectional view taken along line 28-28 of FIG. 27;
FIG. 29 is a cross-sectional view taken along line 29-29 of FIG. 27; and
FIG. 30 is an enlarged cross-sectional view through an oscillating air dispenser.

Numeral references are employed to designate like parts throughout the various figures of the drawing.

Description of Preferred Embodiment

Referring to FIGS. 1, 4, 7 and 13 of the drawings, the numeral 10 generally designates a package that is moved by package handling apparatus 40 into and out of an oven 70 in a vending machine 200. As will be hereinafter more fully explained, a source 90 of electromagnetic radiation and air circulating apparatus 100 are employed for heating a food product 30 selected by a consumer upon depositing the purchase price of the food product in the vending machine 200 illustrated in FIG. 13. As best illustrated in FIG. 13 of the drawing, the vending machine 200 is preferably adapted to serve, for example, hot food products 30 to a customer within about one and a half to two minutes. In the illustrated embodiments, the food products 30 may, for example, include french fried potatoes, chicken nuggets, pizza, submarine sandwiches, bread and other baking products.

The vending machine 200 is mounted in an enclosure cabinet having a back wall 201, spaced side walls 202 and 204, a front panel 205, a top wall 206 and a bottom wall 208. The front panel 205 is preferably hingedly secured to side wall 202 and provided with a key actuated lock 210 securing the front panel 205 in a closed and locked position to prevent unauthorized access to the interior of the enclosure. A currency receiving mechanism 212 adapted to accept both coins and bills is mounted on front panel 205 along with a coin return slot 214 for returning change to the customer.

Selector plates 216, 218, 220 and 222 are mounted on the front panel 205 for use by the customer to designate the food item selected to be heated and dispensed through a delivery passage 224 closed by a protective door 225. Product identification panels 215, 217, 219 and 221 are associated with selector plates 216, 218, 220 and 222, respectively, to inform the customer what food item can be selected by touching one of the selector plates. Identification panel 215 is provided with a graphic illustration of fried potatoes permitting use of the vending machine 200 by persons who do not speak or read a particular language. Additional indicia including words, numerals or other and graphic representations may be applied to each of the panels 215, 217, 219 and 221.

A condiment holding chamber 209 is provided for holding packets of salt, pepper, sugar, ketchup, mustard and barbecue sauce.

As will be hereinafter more fully explained, a refrigerated food storage cabinet 170 is preferably mounted in the lower portion of the interior of the vending machine enclosure 200 and package handling apparatus 40 and oven 70 are mounted above and adapted to receive selected packages of food products from the refrigerated storage compartment 170 transported by an elevator 180.

Each selector plate 216, 218, 220 and 222 is preferably connected to an electrical circuit adapted to initiate a sequence of events provided that payment for the food item 30 has been received in the currency receiving mechanism 212. As will be hereinafter more fully explained, touching selector plate 220 indicates that pizza, graphically illustrated on product identification panel 219 is to be dispensed. A container 10 containing pizza will be automatically moved from the refrigerated storage compartment 170 onto an elevator 180 and delivered to the package handling apparatus 40 which will move the package 10 to oven 70 for heating and then dispense the heated product 30 through the delivery passage 224 which is accessible to the customer by raising door 225.

The electrical circuit controlling the heating of the selected food product 30 preferably includes three programmed elements for delivering a predetermined type of heating for a pre-programmed time interval to the selected food product. The programmable circuit preferably includes, for example, devices to program the heating cycle by coordination with the location of the selected food item in the storage compartment 170, a bar code or other readable mechanism on the package, and symbols displayed on or adjacent selector plates 216-222 for the user to touch. From the foregoing, it should be readily apparent that touching one of the selector plates 216, 218, 220 or 222 based on the visual selection of a food item graphically illustrated on product identification panels 215, 217, 219 or 221 initiates a programmed se-

quence to control the heating cycle of the selected food product 30.

Package 10, best illustrated in FIGS. 7 and 8, comprises a tubular sleeve 12 having open ends 13a and 13b. Sleeve 12 is formed by a top 14, bottom 15 and side walls 16a and 16b having peripheral edges connected to form an interior cavity 17 for a container 18. Bottom 15 is narrower than top 14 and side walls 16a and 16b are inclined relative to vertical planes.

Container 18 is an open topped tray formed by side walls 20 and 21 having end walls 22 and 23 secured between opposite ends thereof and a bottom wall 24. Support ribs 25 or other suitable projections extend upwardly from bottom wall 24 for supporting a food product 30 spaced from bottom wall 24 to provide space forming a path 28 extending between the lower surface 31 of the food product 30 and the upper surface 25a of the bottom wall 24 of container 18.

The package 10 carries the food product 30 in the open-top container 18 which is enclosed in the tube-like sleeve 12. The food product 30 is stored in a cabinet 170 in the container 18 inside of the sleeve covers 12. The container 18 is withdrawn from the sleeve 12 prior to heating the food product 30 and then the food 30 and container 18 are returned to the sleeve 12 to retain heat in the food until the package 10 is opened by the customer.

It should be readily apparent that refrigeration of food product 30 may not be necessary if food product 30 is not perishable or if package 10 containing the food product has been treated to assure that food product 30 has sufficient shelf life. Cabinet 170 may be refrigerated or divided into compartments, some of which are refrigerated depending upon the nature of the food product to be dispensed by the vending machine 200.

The relatively non-conducting sleeve 12 serves as a comfortable holder for the hot container 18 and food 30.

The cover for the container 18, having a lip 19 which extends around the periphery of upper edges of walls 20, 21, 22 and 23, is formed by the top 14 of sleeve 12 to provide a slip-over lid which covers the open top of the container 18 and can be removed for heating and subsequently provides insulated cool handling of the hot product 30 by enclosing the lip 19 of the container 18.

In FIG. 9 of the drawing, the numeral 18a generally designates a modified form of the container having a susceptor belt 27 mounted adjacent bottom 24 of the container having ribs 25 formed thereon. The susceptor belt is formed of polyethylene terephthalate and is commercially available from a variety of sources including Frigigold of England and is recommended for use in reusable plastic or paperboard microwave cook ware in a recommended temperature range of up to 450°F. The susceptor belt 27 is rapidly heated by microwave energy until it reaches a maximum temperature of, for example, 350°F and the temperature level is maintained to provide radiant and conductive bottom heat to the food product 30.

In the embodiment of the container 18 illustrated in FIG. 10 of the drawing, a layer 29 of a particulate food product, such as strips of pasta or slices of potato, is positioned between the bottom wall 24 of container 18 and the lower surface 31 of food product 30. If layer 29 is slices of potato and product 30 is a meat product, juices dripping from the lower surface of food product 30 will contact and be absorbed by layer 29 of potato slices to enhance the cooking of both the slices of potato and the meat product 30. The liquid juices enhance the flavor and appearance of the potatoes while the circulation of air through passages 28 between the potato slices results in controlled drying and evaporation of moisture from the bottom of the food product 30 to provide an acceptable texture, taste, smell and appearance superior to that conventionally achieved in microwave ovens.

As illustrated in FIGS. 15-21 of the drawing, the food product 30a may comprise particulate material, such as slices of fried potatoes and a corrugated susceptor belt 27 is mounted adjacent bottom 24 to form ribs 25. Since the susceptor belt 27 is controllably heated by the microwave and portions of the upwardly extending ribs 25 contact the lower surface of the food product, the structure simulates grilling as well as allowing juices to flow into the area between the ribs.

Container 18b, illustrated in FIG. 15, is provided with a sheet 27a of a heat shrinkable film bonded to lip 19 for sealing the food product 30a in the container 18b. A sheet 27a preferably formed of polymeric compounds and materials, for example, synthetic thermoplastic resins of the type which are commercially available from E. I. DuPont de Nemours and Co. of Wilmington, Delaware, used to form a polyethylene film which will shrink when contacted by air at a temperature of less than 400°F which results in film 27a becoming perforated and shrinking toward lip 19 which extends around the periphery of container 18b. The cohesive nature of the polyethylene material prevents it from dripping into the food container. It should be readily apparent that the use of the polyethylene film 27a provides a seal which prevents deterioration of food product 30a over an extended period of time in a refrigerator or freezer.

A perforated grid or lattice 27b, illustrated in FIG. 16 and FIGS. 18-21, may be mounted between the upper surface of lip 19 and the lower surface of sheet 27a. Legs 27c and 27d spanning across the top of container 18b support film 27a to assure that portions of film 27a do not drop downwardly to engage the food product 30a in container 18b.

As diagrammatically illustrated in FIGS. 18-21 of the drawing, film 27a and lattice 27b are bonded or otherwise sealingly secured to the lip 19 which extends around the periphery of the open top of container 18b to prevent dehydration and to otherwise protect food product 30a in container 18b. Food product 30 is supported on susceptor belt 27 having upwardly extending projections 25 formed thereon for spacing the lower sur-

face of food product 30 above the bottom of container 18b to form air passages therebetween as hereinbefore described.

As illustrated in FIG. 19 of the drawing, impingement of air stream 128a against the upper surface of film 27a causes a central portion of film 27a to be perforated forming an opening 27a' in a central portion of the film intermediate edges of container 18b.

As illustrated in FIG. 20, opening 27a' is enlarged as heat is transferred to the film 27a which tends to roll back as indicated at 27a" as the film material shrinks and is distorted.

As illustrated in FIG. 21 of the drawing, heat transferred to the film 27a causes the meltable and shrinkable film 27a to retract to the position designated 27a'" thereby uncovering the upper surface of food product 30 in container 18b.

It should be appreciated that container 18b is preferably stored in a tubular sleeve 12 of the type hereinbefore described to prevent perforation of sealing film 27a during handling of containers while being transported for stocking storage cabinet 170. As will be hereinafter more fully explained, after container 18b has been moved into heat exchange relation with streams 128a of heated air projected by air circulating apparatus 100, container 18b is reinserted into the tubular sleeve 12 prior to dispensing the food product to the customer so that the hot container 18b and the food product 30 therein can be handled by the customer to eliminate the necessity for providing "hot pads" or other apparatus for handling the hot container.

As best illustrated in FIGS. 1 and 14, package handling apparatus 40 includes a container loading device 50 and a container unloading device 60. The loading device 50 and unloading device 60 are of substantially identical construction and comprise motors 51a and 51b, respectively, drivingly connected through synchronous drive belts 52 to the end of drive screws 56. Each drive screw 56 has threads formed on the outer surface thereof which engage internal threads in a drive nut 55 which moves linearly along drive screw 56 as the drive screw rotates. Thrust is transmitted from the drive nut 55 to a translating tube 57. The entire screw 56 and nut 55 assembly is protected from contamination and environmental elements by a cover tube 58, and an end wiper seal 59. Rotational thrust bearings 54 allow the screw 56 to freely rotate under loaded conditions.

The electro-mechanical linear actuators 50 and 60 are commercially available from Jasta, Inc. of San Jose, California and from Dayton Electric Manufacturing Co. of Chicago, Illinois, and form no part of the invention except in the claimed combination.

Motors 51a and 51b are preferably variable speed reversible synchronous gear motors. It should be readily apparent that motors 51a and 51b transmit torque through belt 52 for rotating drive screws 56. Rotation of drive screw 56 causes drive nut 55 which is secured to the inner end of translating tube 57 to move translating tube 57 to extend or retract tube 57 relative to cover tube 58.

As diagrammatically illustrated in FIG. 5 of the drawing, electro-mechanical actuator 60 having rake plate 57b mounted thereon is pivotally mounted between a pair of lugs 60a and is rocked in a vertical plane by a solenoid 60b connected to an actuating arm 60c secured to cover tube 58 of actuator 60.

When rake plate 57b is in its retracted home position indicated in dashed outline at 57b in FIG. 5 of the drawing, rake plate 57b is preferably positioned tioned at an elevation above container 18 such that when translating tube 57 is extended to the full outline position, the lower edge of rake plate 57b moves above the upper edge of container 18. When rake plate 57b reaches the full outline position illustrated in FIG. 5 of the drawing, solenoid 60b is actuated for moving rake plate 57b downwardly to an elevation below the lip extending around container 18 such that when translating tube 57 is retracted to the dashed outline position, container 18 will be returned through passage 48 in product guide member 46 and returned to the interior of tubular sleeve 12. After container 18 has been deposited in tubular sleeve 12, solenoid 60b will again be actuated for elevating rake plate 57b to a position above the upper edge of opening 48 such that pusher plate 57a may be actuated for moving the next container 18 into the oven.

Conveyor 65 includes a flexible belt 66 extending around a drive roller 66a and a driven roller 66b, drive roller 66a being driven by a reversible variable speed motor 68.

The in-feed conveyor, generally designated by the numeral 42, comprises a paddle 43 suspended between chains 43a and 43b which extend around drive sprockets mounted on a shaft driven by a motor 43d. The in-feed conveyor 42 is mounted between guide members 44 and 46. As illustrated in FIG. 5, guide member 44 comprises a generally L-shaped member formed by substantially perpendicularly disposed legs 44a and 44b connected by a transition section 44c. Product guide member 44 is connected to a second product guide member 46 by a front bracket 42f and a rear bracket 42r. As illustrated in FIG. 1 of the drawing, an in-feed drive motor 43d is secured to guide member 46 and paddle 43 is moved between guide members 44 and 46 by chains 43a and 43b.

Product guide member 46, best illustrated in FIG. 5, is formed by generally perpendicularly disposed legs 46a and 46b connected by a transition section 46c. A third leg 46d extends generally parallel to leg 46b and has an end secured to an end of leg 46b by stop member 45. As will be hereinafter more fully explained, stop member 45 functions as a stop to limit movement of package 10.

Leg 46b of product guide member 46 has a first passage 47 formed therein while section 44d has a second passage 48 formed therein. As will be hereinafter more fully explained, when conveyor 65 moves package 10

into engagement with backstop 45, the open end 13a of tubular sleeve 12 is positioned adjacent opening 47 while the open end 13b of sleeve 12 is positioned adjacent passage 48. When motor 51a of the linear actuator of loader assembly 50 is energized, tube 57 and push plate 57a on the end thereof will move through passage 47 and through the open end 13b of sleeve 12 for moving container 18 through the open end 13a of sleeve 12 and through passage 48 into a cooking chamber in oven 70. After container 18 is positioned in the cooking chamber, motor 51a is reversed, thereby retracting translating tube 57 and push plate 57a to the position illustrated in FIG. 1 of the drawing.

After the product 30 in container 18 has been heated, motor 51b of the linear actuator of the unloading assembly 60 will be energized to extend the translating tube 57 of the unloading assembly 60 causing the rake plate 57b to move into the cooking compartment above container 18 and then pivot downwardly for engaging lip 19 on end wall 23 on container 18. Motor 51b is then reversed for retracting tube 57 and rake plate 57b for urging container 18 out of the oven 70, through passage 48 and through the open end 13a of sleeve 12. When motor 68 is energized, the heated food product 30 in container 18 which has been repositioned in sleeve 12 will be moved toward the delivery end of conveyor 65.

Product guide members 44 and 46 are bolted or otherwise secured to the upper surface of loader base member 42a upon which in-feed conveyor 42 and delivery conveyor 65 are mounted.

The oven 70 comprises spaced side walls 72 and 74, a back wall 76 and a front wall 78. Front wall 78 has an access opening 79 formed therein which is opened or closed by a door 80. A microwave trap 81 is formed around door 80 and is configured to prevent passage of microwave energy through space between the periphery of the door 80 and walls of the cabinet 70. Top wall 71 and bottom wall 73 close upper and lower ends of oven 70. Each wall of the oven is preferably formed by spaced metallic sheets and the space between the sheets is filled with thermal insulation material.

An actuator 82, secured to mounting bracket 82a, is connected through a link 84 to door 80 for moving door 80 vertically relative to access opening 79. Actuator 82 is preferably an electro-mechanical actuator of the type illustrated in FIG. 14 and is driven by a motor 51a.

Referring to FIGS. 1 and 2 of the drawing, the electromagnetic radiation device generally designated by the numeral 90 in the illustrated embodiment comprise a pair of magnetrons 92 connected to wave guides 93 formed in side walls 72 and 74 of oven 70. The magnetrons 92 supply electromagnetic energy to wave guides which carry the energy to the cooking chamber. A preferred microwave frequency is 2450 megahertz. Magnetrons 92 are conventional vacuum tubes in the microwave oven that convert electrical energy to electro magnetic energy in the microwave frequency spectrum. Waves of microwave energy are similar to radio waves except they are higher frequency than radio waves and lower frequency than ordinary light waves. The microwave energy is channeled through wave guides 93 from the magnetrons 92 into the cooking chamber 120.

As illustrated in FIG. 2 of the drawing, the side walls 72 and 74 are formed by spaced sheets 74a and 74b and insulation material 74c is configured to form a guide tube 93 having a lower end 94 which is inclined at an angle 95 relative to a vertical plane 96 at an angle in a range between 15° and 75°. In the illustrated embodiment, the angle 95 is approximately 45°

The application of microwave radiant heating is delivered from two sides and angles downwardly toward food 30 in an open top container 18. Since the container and the food in the container do not reflect microwaves significantly and since the space under the container diffuses microwave which passes through or by the container the beam from one wave guide is not reflected directly into the other but is largely retained in the heating chamber.

Since the container 18 is non-metallic, reflections from one wave guide 93 are not reflected into the other to keep microwave in the chamber 120 to effectively heat the food 30.

The support for the open package is preferably less than 25% reflective of the microwave.

The reflective surface of the bottom 24 of the container 18 is greater than one-fourth wave length, for 2450 megahertz (MHZ) microwave one-fourth of 13 cm, below the surface of food being heating. The angle and the distance reduce standing waves in the small heating cavity.

A tube 103 is connected through a valve 103a to a supply of water or steam and which may be used for delivering an atomized spray of water or steam into the air conditioning chamber 115 for controlling the relative humidity and dew point of air circulated through air conditioning chamber 115 and cooking chamber 120.

Referring to FIGS. 2, 3 and 4 of the drawing, air circulating apparatus generally designated by the numeral 100 comprises a blower housing 102 having an inlet opening 104 and a discharge opening 106. As illustrated in FIGS. 2 and 4, blower housing 102 is in the form of a volute and a plenum section 108 is formed adjacent the discharge opening 106.

A radial flow fan impeller 110 draws air axially through inlet opening 104 and discharges air radially through plenum section 108 and discharge opening 106.

A heating element 112 having coils 113 of a first stage and coils 114 of a second stage is mounted for heating air drawn into the blower housing 102.

As best illustrated in FIG. 3 of the drawing, the interior of the oven cabinet 70 is divided by a perforated plate 75 to form an air conditioning chamber 115 and a cooking chamber 120. Perforated plate 75 is constructed of a metallic material and has perforations 76a with relatively small openings preferably equivalent to more

than 50% of the surface area. The perforated metal plate 75 prevents microwave energy from passing into the air conditioning chamber 115.

The perforated plate 75 forms a splatter shield on which airborne spoil accumulates. Referring to FIGS. 27, 28 and 29 of the drawing, perforated plate 75 is preferably a single sheet of metallic material having rows of slits 77 which extend longitudinally of the sheet. Central portions of the sheet are deflected along lines 77a, 77b, 77c and 77d, without removing material from the sheet to form air passages through the sheet. Between adjacent slits 77 sections of the central portions of the sheet are deflected upwardly to form upwardly extending ridges 75a, by bending the material along lines 77a, 77b, 77c and 77d. Other segments of the sheet are deflected to form downwardly extending ribs 75b by bending the material downwardly along fold lines 77a-77d.

When adjacent segments 75a and 75b of sheet 75 are deflected in opposite directions air passages 75c are formed in the sheet.

The perforated partition 75 constructed of metallic material and due to its geometric configuration forms a barrier which prevents passage of microwave energy into the air conditioning chamber 115. This significantly contributes to reducing the propagation of microwave energy through passages formed in the wall of the air conditioning compartment through which fan drive shafts, electrical conductors, steam injectors, and ventilation ducts are mounted.

Further, the perforated sheet 75 significantly aids in removing grease and other particulate material from the recirculating air and is preferably mounted for easy removal for cleaning.

In heavy duty food service ovens, cleaning is a major consideration.

Sheets of the same perforated material are preferably mounted to form removal splatter shields 75s adjacent opposite sides of the food product to form an oven liner which is easily removable for cleaning. Soil collector pans or trays 165 extend around the food product to catch any food particles which may be dislodged from the cooking container during the cooking process.

A coating or layer 75d of non-conductive insulator material is applied to at least one surface of the perforated sheet 75. If it is deemed expedient to do so, only top surfaces of deflected portions 75a between fold lines 77b and 77d may be coated with insulator material to prevent microwave arcing between surfaces of perforated sheet 75 and a metallic pan surface.

Microwave energy at a frequency of 2,450 megahertz tends to arc when two metal surfaces approach each other at a low angle. The arcing not only wastes heating energy, it can cause fires in dry products and can pit the metal surfaces.

Heretofore, applying porcelain coatings to flat metallic sheets to prevent arcing has resulted in the porcelain coating tending to chip and crack when the flat sheet of metal is deflected. However, the perforated sheet 75 having portions 75a and 75b deflected outwardly in opposite directions from a central planar portion 75p is relatively stiff which significantly reduces the tendency of the ceramic coating 75d to crack or chip.

As best illustrated in FIG. 3 of the drawing, the first stage of coils 113 is mounted in air conditioning chamber 115 outside of the blower housing 102 while the second stage of coils 114 is mounted inside blower housing 102. Terminals 112a and 112b of heating element 112 are connectable to a suitable source of electricity.

As illustrated in FIG. 4 of the drawing, a mounting plate 116 having a notch 117 formed in the periphery thereof and a central opening 118 is bolted or otherwise secured to blower housing 102 for supporting heating element 112. Plate 116 is formed in two parts which are connectable along a part line 119.

As illustrated in FIG. 3, blower 110 is mounted on a shaft which is driven through a coupling 111 by a motor 110a.

Coils of a third stage heating element 109 are mounted in the plenum section 108 of blower housing 102 and positioned such that air delivered radially from blower 110 is heated immediately prior to being delivered through discharge opening 106. It should be readily apparent that only coils 109 may be activated while coils 113 and 114 are idle, if it is deemed expedient to do so depending upon the heating requirements of a particular food product.

An air dispensing duct generally designated by the numeral 125 is secured to plenum 108 for receiving air from discharge opening 106.

As best illustrated in FIGS. 3 and 4 of the drawing, air dispensing apparatus 125 comprises a tapered duct formed by a perforated plate 126 having an array of passages formed therein which communicate with tubes 128. A front wall 130 and a rear wall 132 extend upwardly from the perforated plate 126 and are connected between side walls 134 and 136. An inclined top wall 138 extends between front wall 130 and a flange 140 encircling the lower end of plenum 108 and enclosing the discharge opening 106 from the blower housing 102.

As illustrated in FIG. 3 of the drawing, air directing vanes 143 extend between side walls 134 and 136 of the tapered duct 125 for distributing air along the length of the interior 144a of the tapered duct 125. Air directing vanes 143 are configured to deliver temperature controlled air into the duct substantially parallel to a longitudinal axis 125a of duct. Streams 128a and 128b of air are directed transversally of the axis 125a from said duct toward the food product 30. As the duct reciprocates about the axis 142a of pin 142, which is parallel to the axis 125a of the duct, streams 128a and 128b of air impinge on discrete areas on the surface of the food product 30 to transfer heat between the air streams and the surface of the food product 30.

The air dispensing apparatus 125 is pivotally secured to duct plenum 108 by a pivot pin 142 extending through aligned apertures 144 in flange 140. Pivot pin

142 extends into an opening 145 formed in lug 146 on shaft 148 which extends into an aperture 149 on a link 150. Link 150 has an elongated slot 152 formed therein into which a pin 154 on crank 155 extends.

Crank arm 155 has an aperture which receives a drive shaft 158 driven by motor 160 through a gear reducer 161.

A radial blower 110 discharges its highest velocity air from the outer portion of the volute downwardly through shaped openings in tubes 128 to impinge upon a narrow food product 30 in the open top container 18.

The air dispensing duct 125 is moved relative to the product 30 to give uniform coverage by the air streams. As best illustrated in FIGS. 11 and 12, the end walls 22 and 23 of the container 18 cause a portion of the air stream to be deflected to heat the sides and bottom 31 of product 30 in the container. The movement applies the air streams near one side of the container adjacent end wall 22 and then to the other side adjacent end wall 23 so that parts of the air streams are alternately applied to opposite exposed sides of the product 30 and are caused to alternate the lateral flow through loose stacks of food products 30 such as curled or random lengths of french fried potatoes. This alternating lateral air flow through paths 28 between support ribs 25 passes under and heats the lower side 31 of irregularly shaped products such as bone-in chicken parts.

The effectiveness of the sideways air heating of lower surfaces 31 can be enhanced by ribs 25 to provide air passages under flat products.

Further, the moving air dispensing apparatus 125 provides moving reflective surfaces which serve as stirrers to help distribute the microwave energy in the cooking chamber 120.

The combination of extended orifices through tubes 128, and the open top container 18 provides air escape path 129 while bringing the orifice to an optimum distance from the product 30. It should be noted that upper edges of the sides 20 and 21 and ends 22 and 23 of container 18 extend above the height of the contained product 30 to enhance air flow between the lower surface 31 of the product 30 and the bottom 24 of container 18.

As illustrated in FIG. 2 of the drawing, streams of air dispensed from air dispensing duct 125 through hollow air dispensing tubes 128 impinge upon the upper surface of a food product 30 in container 18. The spent air travels through space 129 between tubes 128, as illustrated in FIGS. 11 and 12 of the drawing. Spent air travels upwardly adjacent baffles 75s and the recirculating air is drawn upwardly through passages 75c formed in the perforated plate 75.

Soil collector pans 165 are preferably removably mounted and are maintained at a temperature which is less than the temperature of any other surface in the oven 70 for causing very fine smoke-type particles in the moving air to be collected on the coldest surface in the recirculating path. To assure that the soil collection pans 165 are maintained cooler than other surfaces in oven 70, the pans may be exposed to outside air or water cooling to facilitate collecting aerosol from the recirculating air.

From the foregoing it should be readily apparent that the disclosed method for controlling the temperature and surface texture of a food product which is to be delivered from vending machine 200 generally comprises delivery of a suitably packaged and preserved food product from a storage compartment 170 to an oven 70. The package 10 is positioned by back stop member 45 in a predetermined relationship relative to electro-mechanical linear actuators 50 and 60 and relative to access opening 79 communicating with cooking chamber 120 in oven 70.

Actuation of the actuator of the loading device 50 results in movement of push plate 57a through tubular sleeve 12 for pushing container 18b out of sleeve 12 and into the cooking chamber 120. Streams 128a of air delivered through tubes 128 of the air circulating apparatus 100 melts and shrinks film 27a for uncovering food product 30 in the open top container 18b.

In the embodiment illustrated in FIG. 15 of the drawing, one or more air streams 128a, after causing the food product 30a in container 18 to be uncovered will be delivered through the open top of container 18b. If the food product 30a in the container is strips or slices of pasta, potatoes or other particulate material, air from stream 128a will be delivered through the stacked material in heat transfer relation with the surface of the pieces of the food product.

If food product 30 is a solid article as designated by the numeral 30 in FIGS. 11 and 12 of the drawing, air dispensing duct 125 is preferably rocked causing air streams 128a and 128b to move across the surface of the food product between lateral edges thereof such that regions of controlled air pressure are alternately formed adjacent opposite sides of the product 30 such that temperature controlled air flows through passage 28 between the lower surface 31 of the food product and the upper surface 25a of the bottom 24 of container 18.

After the surface of the food product 30 has been heated by air streams 128a and 128b, the recirculating air tends to limit localized heating of the product by microwave energy delivered by magnetrons 92. Tips, and thin areas of the product which are rapidly heated by the microwave energy may actually dissipate heat to air in streams 128a and 128b to provide cooling to certain portions of the food product.

After the food product 30 in container 18 has been sufficiently heated, air flow through the air circulating apparatus 100 is terminated, magnetrons 92 are turned off and blower actuator 82 is energized for moving the door upwardly to the position illustrated in FIG. 1 of the drawing. The electro-mechanical actuator of the container unloading device 60 is then actuated for moving rake plate 57b from the dashed outline position in FIG. 5 of the drawing to the full outline position. Rake plate 57b

is then lowered and retracted for moving container 18 out of the oven and redepositing the hot container and the food therein in the tubular sleeve 12.

After the heated food product and container 18 have been moved into the protective tubular sleeve 12, conveyor 65 is energized for moving the heated food product toward the delivery passage 224 of the vending machine 200 such that the product is accessible to the customer by opening protective door 225.

SECOND EMBODIMENT

A second embodiment of the oven is illustrated in FIGS. 22-30 of the drawings.

The second embodiment of the oven, generally designated by the numeral 270, in FIGS. 22-25 of the drawing, comprises spaced side walls 272 and 274, a back wall 276 and a front wall 278. The front wall 278 has an access opening 279 formed therein which is opened and closed by a door 280. A top wall 271 and a bottom wall 273 close upper and lower ends of the oven 270. A microwave trap 281 is formed around door 280 and is configured to prevent passage of microwave energy through space around the door.

Magnetrons 292a and 292b are connected to wave guides 293a and 293b which extend horizontally across an upper portion of the oven. Microwave energy is delivered into an interior compartment in oven 270 through openings 296a and 296b.

As best illustrated in FIGS. 22 and 25, opening 296b is formed in top wall 271 adjacent the door 280 and is positioned substantially equal distances between side walls 272 and 274. Opening 296a extends through top wall 271 rearwardly of opening 296b and wave guides 293a and 293b are positioned perpendicular to each other.

As best illustrated in FIGS. 22 and 25 of the drawing, wave guide 293a extends longitudinally of the oven, magnetron 292a being mounted adjacent the rear wall 276 of the oven. Electromagnetic energy is delivered from magnetron 292a through wave guide 293a extending longitudinally of the centerline 270c of the oven 270 into the oven through an opening 296a.

The second magnetron 292b is mounted adjacent a side wall 274 of the oven and delivers microwave energy through a horizontally disposed wave guide 293b, extending perpendicular to the centerline 270c of the oven, and through outlet 296b into the cooking chamber 320.

Microwave energy traveling through a wave guide into a microwave cooking cavity tends to form hot spots which are 2.4 inches apart directly below the opening into the cooking chamber, the hot spots being aligned with the length of the wave guide. Providing two wave guides 293a and 293b which extend perpendicular to each other results in the formation of four hot spots positioned adjacent four corners of a square.

Referring to FIGS. 22, 23 and 24 of the drawing, air circulating apparatus generally designated by the numeral 300 comprises a blower housing 302 having upper and lower discharge openings 306a and 306b which extend horizontally above and below a radial flow fan impeller 310. A heating element 312 is mounted adjacent the inlet 304 into the fan housing.

As best illustrated in FIG. 25, the interior of the cabinet 270 is divided by a foraminous splatter shield 275 to form an air conditioning chamber 315 and a cooking chamber 320. The partition 275 is preferably the same material as the partition 75 hereinbefore described in the description of the first embodiment and illustrated in FIGS. 27, 28 and 29 of the drawing. In the illustrated embodiment of the invention, the air conditioning chamber 315 is spaced horizontally from the cooking chamber 320 so that the air conditioning chamber 315 is in the back of the oven and the cooking chamber 320 is in a front portion of the oven.

As best illustrated in FIG. 22, the foraminous partition 275 has a central portion 275a and extremities 275b and 275c configured to encircle a portion of the cooking chamber 320 such that the air conditioning chamber 315 extends around a major part of the periphery of the cooking chamber 315. Air is drawn along multiple paths toward side walls 272 and 274 and toward rear wall 276 from cooking chamber 320.

An upper plenum 308a and a lower plenum 308b are formed by a plenum wall 316 extending generally parallel to back wall 276. Plenum wall 316 has a generally vertically extending central portion 316a and generally horizontally extending upper and lower portions 316b and 316c, respectively. The central portion 316a has an opening 304 in which radial flow fan 310 is mounted.

A pair of circular tubular members 317 extend outwardly from spaced openings in the upper portion of the plenum wall and telescopically extend into circular sleeves 340 formed on air dispensing ducts 325a and 325b which oscillate about spaced axes 325x and 325y, as will be hereinafter more fully explained.

Referring to FIGS. 26 and 30, each air dispensing duct 325a and 325b comprises a body portion having a tapered cross section formed between space side walls 334 and 336 having outward extending flanges formed thereon.

A sheet of perforated material 343 having large and small apertures 343a and 343b formed therein is supported inside of each tapered duct 325a and 325b. A jet plate 326 having a plurality of spaced apertures 328 formed therein has inwardly projecting guide surfaces formed on upper ends of side walls such that the jet plate 326 is suspended from the flange extending along lower edges of side walls of the tapered ducts. The jet plate 326 is slidable longitudinally of the tapered duct so that it can be easily removed for cleaning.

The perforated plate 343 mounted inside the tapered duct has openings to form a slight back pressure in each tapered duct to maintain air pressure substan-

tially uniform longitudinally of the duct. The combination of the tapered cross section of the duct and the perforated plate 343 contribute to provide a uniform air flow through-each of the orifices 328 formed in the jet plate 326.

Further, openings 343a and 343b in the perforated plate 343 are configured to prevent passage of microwave energy from the cooking compartment 320 into the air dispensing ducts 325a and 325b.

As best illustrated in FIGS. 23 and 24 of the drawing, air dispensing ducts 325a and 325b comprise tapered ducts similar to the duct 125 described in connection with the first embodiment.

As best illustrated in FIG. 26 of the drawing, each air dispensing duct 325 comprises a tapered duct formed by a perforated plate 326 having an array of passages 328 formed therein. A front end wall 330 and a rear end wall 332 extend upwardly from the perforated plate 326 and are connected between side walls 334 and 336. The inclined top wall 338 extends between front wall 330 and a flange or sleeve 340 encircling tubular member 317 which forms an outlet from plenum 308.

The air dispensing apparatus 325a and 325b is pivotally secured to tubular member 317 by a pivot pin 342 extending through an aperture 344a in hanger 344.

A shaft 345 is welded or otherwise secured to cross members 345a an 345b which extend diametrically across tubular sleeve 340.

As best illustrated in FIG. 26 of the drawing, a disk 346 is mounted on the outer end of each shaft 345 and a connector link 348 is pivotally secured between disks 346 on shafts 345 of each air dispensing duct 325a and 325b.

One of the disks 346 is connected through a link 349 to a disk 355 mounted on the end of a drive shaft 358 from a gear drive driven by a motor 360.

From the foregoing it should be readily apparent that motor 360 rotates disk 355 which imparts reciprocating motion through link 349 to disks 346 mounted on shafts 345. As link 349 reciprocates the oscillatory motion of one disk 346 is transferred to the second disk 346 such that air dispensing ducts 325a and 325b reciprocate in unison relative to the food product 30 to provide uniform coverage by the air streams.

A lower tapered duct 325c, best illustrated in FIG. 24, which is significantly wider than the upper oscillating air dispensing ducts 325a and 325b delivers air streams upwardly to impinge against the bottom of a pan or a product supported on a rack 327 in the bottom of the oven.

From the foregoing it should be readily apparent that the apparatus hereinbefore described for transferring heat between temperature controlled air and a food product has multiple air dispensers 325a and 325b. Oscillation of multiple ducts 325a and 325b provides a more uniform sweeping action of air streams which project into the cooking chamber than could be accomplished with a single jet plate having apertures spaced across the entire length of the cooking chamber. The multiple air dispensers remain a substantially uniform distance from a food product in the cooking chamber as the air streams are moved across the surface of the food product.

The foraminous partition 275 having a configuration approximating that of the cooking chamber forms foraminous walls 275a, 275b and 275c around the food product for collecting any material which may splatter during the cooking process. Further, the foraminous walls 275a, 275b and 275c spaced from side walls 272 and 274 and rear wall 276 form a generally U-shaped air conditioning chamber 315 around the cooking chamber 320. Spent air flowing from the cooking chamber is drawn through openings in the foraminous side partition walls 275b and 275c and also through the central rear foraminous partition wall 275a. Thus, it should be readily apparent that air dispensed into the cooking chamber through the oscillating upper air dispensing ducts will be drawn away from opposite sides of the row of openings 328 formed in each air dispensing duct 325a and 325b. This minimizes the possibility that spent air will be drawn along a path which will wash out air streams dispensed from the air dispensing ducts.

Openings 328 in the upper air dispensing ducts 325a and 325b are preferably larger in diameter than the openings 329 formed in the lower air dispensing duct 325c.

It has been observed that air delivered through an orifice can be projected a distance about eight times the diameter of the opening before it loses its integrity and significantly diffuses. In a preferred embodiment of the invention, openings in the upper air dispensers are preferably, for example, about one inch in diameter and the upper surface of the food product is in a range between about two inches and eight inches from the lower surfaces of the oscillating ducts 325a and 325b.

Openings formed in the lower jet finger, in the illustrated embodiment, are configured to impinge against a lower pan surface constructed of thermally conducted material. Thus, the lower tapered duct 325c is provided with smaller openings 329 spaced closer together than those formed in the upper air dispensing ducts 325a and 325b. In a preferred embodiment, the lower tapered duct is provided with apertures having a diameter of for example one-half inch and are positioned in a range between one and four inches of the bottom of the pan supporting the food product.

In the illustrated embodiment, the pan containing the food product does not move relative to the lower air dispensing duct.

In certain applications, if heat is not conducted by the pan away from spots upon which the lower jets impinge fast enough to provide substantially uniform heating to the bottom of the food product, either the lower jet finger or the product support may be moved relative to the other for sweeping air streams across the bottom

surface of the pan.

It should be readily apparent that the foraminous partition 275a, plenum wall 316 and the perforated plate 343 inside each air dispensing duct 325a and 325b creates zones of differential pressure throughout the oven compartment for enhancing and controlling air flow therethrough. The radial flow fan 310 draws air from the air conditioning chamber 315 creating an area of low pressure and delivers air into the upper and lower plenums 308a and 308b creating areas of high air pressure. The perforated plates 343 in the upper and lower air dispensing ducts 325a and 325b and in the lower air dispensing duct 325c create a slight back pressure in each air dispensing duct for maintaining substantially uniform air pressure longitudinally of each air dispensing duct even though openings 328 and 329 are formed in the air dispensing ducts.

Since the foraminous partition 275 extends around a substantial portion of the periphery of the cooking chamber 320, air is drawn along multiple paths away from the food product 30 after the air streams impinge against the surface of the food product and diffuse. This allows the spent air to be expeditiously removed from the cooking chamber while minimizing diffusion of the air streams before they impinge upon the surface of the food product.

Further, the foraminous partition 275 is easily removable from the cooking chamber when door 280 is opened for cleaning or replacement with a clean foraminous partition.

The shape and configuration of the foraminous partition 275 facilitates collection of splattered material and its position in the stream of recirculating air causes it to be maintained at a temperature which is lower than the temperature of other surfaces in the cooking chamber. It should be readily apparent that spent air which impinges against the surface of a cold food product 30 will be at a lower temperature when it passes through the foraminous partition than air in the air stream which has been heated by the heating elements 312 in the air conditioning chamber 315 and delivered through the plenum to the air dispensing ducts 325a and 325b. Airborne particles and smoke in the circulating air tends to be collected on the coolest surfaces in the oven. This prevents transfer of airborne contaminants into the air conditioning chamber 315 for accumulation on surfaces which are difficult to clean.

As noted above, passages in the foraminous partition 275 are configured to prevent the transfer of microwave energy from the cooking compartment 320 into the air conditioning compartment 315 which significantly reduces the possibility of leakage of microwave energy through openings in the air conditioning compartment through which fan motor drive shafts, electrical conductors and the like extend.

The positioning of oscillating air dispensers 325a and 325b closely adjacent opposite sides of openings 296a and 296b through which microwave energy is delivered into the cooking chamber stirs the microwave as the air dispensing ducts oscillate. Moving surfaces of the oscillating ducts also change constantly to diffuse standing waves of reflected microwave energy in the cooking compartment. Any hot spots formed by the microwave energy in the cooking compartment are diffused by the oscillating ducts as the air streams are swept through the cooking chamber to provide more uniform heating by both the microwave energy and the impinging air streams.

Since microwave energy is contained in the cooking compartment and isolated from the air conditioning compartment, fresh air may be circulated through the air conditioning compartment 315 if it is deemed expedient to do so for removing smoke and eliminating rancid odors.

The transfer of heat between temperature controlled air and a food product is enhanced by delivering temperature controlled air, substantially parallel to an axis 125a in the embodiment of Fig. 3 or axis 325x in the embodiment of Fig. 24, into the air dispensing duct because air is uniformly distributed and air pressure is substantially constant along the length of each duct. This improves the efficiency of the air flow for dispensing streams of air from the duct toward the food product in a direction generally transverse of axis 325x and generally perpendicular to the food surface.

Reciprocation of the duct about axis 325x sweeps the streams of air that impinge on discrete areas on the surface of the food product across the surface of the food product.

Claims

1. A method for transferring heat between temperature controlled air and a food product comprising:

   providing a volume of temperature controlled air;
   delivering temperature controlled air substantially parallel to a longitudinal axis (125a;325x) of an air dispensing means which includes an elongated hollow duct (125;325) having an interior and positioned parallel to said longitudinal axis (125a;325x);
   dispensing a stream of air from said duct (125;325) toward the food product in a direction generally transverse to said longitudinal axis (125a;325x); and
   reciprocating said duct (125;325) about a reciprocating axis (142a;325x) that is parallel to said longitudinal axis (125a;325x) whereby said stream of air impinges on discrete areas on the surface of the food product as said duct reciprocates.

2. A method of transferring heat according to claim 1,

the step of delivering temperature controlled air substantially parallel to an axis into a duct comprising the steps of:

delivering air through an array of air directing vanes (143) for distributing air along the interior of the elongated hollow duct.

3. A method of transferring heat according to claim 1, the step of delivering temperature controlled air substantially parallel to a longitudinal axis into a duct comprising the steps of:

delivering air through a tubular member (317); and
mounting said duct for reciprocal movement about said tubular member.

4. A method for transferring heat according to claim 1, the step of delivering temperature controlled air substantially parallel to said axis into a duct comprising the steps of:

drawing spent air resulting from impingement of said stream on discrete areas on the surface of the food product along an air return path;
positioning a foraminous member (75;275) having passages formed therein whereby said spent air flows through said passages in said foraminous member, said foraminous member being configured whereby airborne particles in said spent air are retained by said foraminous member.

5. A method according to claim 4, said foraminous member forming a removable splatter shield extending across said return path.

6. A method of transferring heat according to any one of claims 1 to 4, said elongated hollow duct having microwave reflective surfaces; and with the addition of the step of delivering microwave energy such that said microwave reflective surfaces stir and distribute the microwave energy.

7. A method of transferring heat according to any one of claims 1 to 4, wherein air is delivered substantially parallel to longitudinal axes (325x) of multiple air dispensing ducts (325a,325b) and reciprocating each of said ducts about spaced reciprocating axes.

8. Apparatus for transferring heat between temperature controlled air and a food product comprising:

a plenum (308) having an air return opening (304);
a substantially circular outlet (317) on said plenum (308) having a central axis (325x);
an elongated duct (325a,325b) having a substantially circular entrance opening (340) and an outlet opening (328);
means (345-360) supporting said duct for reciprocal movement about said central axis (325x); and
a substantially circular coupler (317,340) having a longitudinal axis (325x) for placing said substantially circular entrance opening in said duct in fluid communication with said substantially circular outlet (317) on said plenum whereby air is delivered substantially parallel to said longitudinal axis (325x) from said plenum (308) into said duct, said central axis (325x) and said longitudinal axis (325x) being substantially parallel.

9. Apparatus for transferring heat between temperature controlled air and a food product according to claim 8, said coupler comprising:

a sleeve (340) configured to encircle a portion of said substantially circular outlet (317).

10. Apparatus for transferring heat between temperature controlled air and a food product according to claim 8, said coupler comprising:

means delivering air through said entrance opening in a direction substantially parallel to said axis about which said duct reciprocates.

11. Apparatus for transferring heat between temperature controlled air and a food product according to claim 10, said outlet opening (328) in said duct (325) being configured to dispense a stream of air to impinge against the surface of a food product.

12. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 8 to 11, with the addition of:

an array of air directing vanes (143) in said elongated duct for distributing air in said elongated duct between said substantially circular entrance opening and said outlet opening.

13. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 8 to 11, said elongated duct comprising:

a body portion having a tapered cross-section formed between spaced side walls; and
a plate (326) extending between said spaced side walls, said outlet opening (328) being formed in said plate.

14. Apparatus for transferring heat between temperature controlled air and a food product according to claim 13, said plate having a plurality of spaced outlet openings; and

a perforated plate (343) in said elongated duct adjacent said plate (326) to form a slight back pressure in said elongated duct to maintain air pressure substantially uniform longitudinally of said elongated duct.

15. Apparatus for transferring heat between temperature controlled air and a food product according to claim 13, said perforated plate having an array of passages (343a,343b) through which air flows to said outlet openings (326).

16. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 8 to 11, said means supporting said duct for reciprocal movement about said axis comprising:

at least one cross member (345a,345b) secured to said elongated duct and extending across said entrance opening; and
a shaft (345) secured to said cross member.

17. Apparatus for transferring heat between temperature controlled air and a food product according to claim 16 said means supporting said duct for reciprocal movement about said axis further comprising:

a link (349) mounted for reciprocal movement connected to said shaft whereby reciprocal movement of said link causes said shaft and said elongated duct to oscillate about said axis (325x).

18. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 8 to 11, said elongated duct having a microwave reflective surface (326) which reciprocates about said axis.

19. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 8 to 11, said elongated duct having angularly inclined surfaces (326,346).

20. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 8 to 11, with the addition of a foraminous member (275) formed to prevent passage of microwave energy along an air return path to said return opening (304) in said plenum.

21. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 8 to 11, said outlet opening (328) from said elongated duct (325a,325b) being formed in a jet plate (326) slidable longitudinally of said duct so that it can be easily removed for cleaning.

22. Apparatus for transferring heat between temperature controlled air and a food product comprising:

a cabinet (270) having an interior compartment;
front, side and rear walls (272-278) on said cabinet extending around said compartment;
a plenum wall (316) in said compartment having an opening (304), said plenum wall forming a plenum (308) in said compartment;
partition means (275) spaced from said plenum wall dividing the interior of the cabinet into a cooking chamber (320) and an air conditioning chamber (315);
air circulating means (310) drawing air from said cooking chamber to pressurize said plenum:
temperature control means (312) in said air conditioning chamber for controlling temperature of air in said air conditioning chamber;
air dispenser means (325) having a longitudinal axis (325x);
means (317,340) mounting said air dispenser means (325) such that pressurized air from said plenum is delivered substantially parallel to said longitudinal axis (325x) into said air dispenser means and whereby spaced streams of air are dispensed transversely of said longitudinal axis toward a food product in said cooking compartment; and
means (360) for reciprocating said air dispenser means about a reciprocating axis (325x) that is parallel to said longitudinal axis (325x) for causing said air streams to sweep over the surface of the food product.

23. Apparatus for transferring heat between temperature controlled air and a food product according to claim 22, said air dispenser means comprising:

an elongated duct having a tapered cross-section formed between spaced side walls; and
a plate (326) extending between said spaced side walls, said outlet opening (328) being formed in said plate.

24. Apparatus for transferring heat between temperature controlled air and a food product according to claim 22, said air dispenser means comprising:

first and second elongated ducts having microwave reflective surfaces and each of said ducts having an entrance opening and an outlet opening, said means (360) for reciprocating said air dispenser means moving said ducts such that said microwave reflective surfaces on each of said ducts move to distribute microwave energy within the cooking compartment.

25. Apparatus for transferring heat between temperature controlled air and a food product according to

claim 22, said partition means (275) spaced from said plenum wall dividing the interior of the cabinet into a cooking chamber (320) and an air conditioning chamber (315) comprising:

a foraminous member (275) having deflected portions (75a, b, c) formed to provide passages on opposite sides of said deflected portions wherein streams of air flowing in a first direction generally perpendicular to said foraminous member form a plurality of streams of air flowing generally parallel to said formanious member which collide to change direction to said third direction generally perpendicular to said foraminous member.

26. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 22 to 25, said means (317,340) mounting said air dispenser means comprising:

a circular tubular member (317) extend outwardly from said plenum wall; and
sleeve means (340) configured to telescopically receive a portion of said circular tubular member (317).

27. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 22 to 25, said partition having a non-conductive coating to electrically insulate said partition.

28. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 22 to 25, said partition means having a central portion and extremities configured to encircle a portion of said cooking chamber such that said air heating chamber extends around a major part of the periphery of the cooking chamber wherein air is drawn along multiple paths toward said side walls and toward said rear wall from said cooking chamber.

29. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 22 to 25, said partition means comprising:

a sheet having portions deflected outwardly in opposite directions from the plane of the sheet to form passages through which air flows in a direction generally parallel to the plane of the sheet while blocking air flow in a direction generally perpendicular to the plane of the sheet.

30. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 22 to 25, said air dispenser comprising:

a plurality of air dispensing ducts; and drive means for reciprocating each of said air dispensing ducts in said heating chamber.

31. Apparatus for transferring heat between temperature controlled air and a food product according to claim 30, said drive means for reciprocating each of said air dispensing ducts comprising:

a motor;
a drive member driven by said motor; and
a plurality of links extending between said drive member and said air dispensing ducts.

32. Apparatus for transferring heat between temperature controlled air and a food product according to any one of claims 22 to 25, with the addition of:

microwave heating means communicating with said cooking chamber, said partition means preventing transfer of microwave energy from said cooking chamber to said air conditioning chamber.

33. Apparatus for transferring heat between temperature controlled air and a food product according to claim 30, with an additional drive means connected to each of said air dispensing ducts for causing said ducts to move in unison.

34. Apparatus for transferring heat between temperature controlled air and a food product according to claim 22, said means mounting said air dispensing means comprising:

a substantially circular outlet on said plenum having a central axis;
an elongated duct having a substantially circular entrance opening and an outlet opening;
means supporting said duct for reciprocal movement about said central axis; and
a substantially circular coupler having a longitudinal axis for placing said substantially circular entrance opening in said duct in fluid communication with said substantially circular outlet on said plenum whereby air is delivered substantially parallel to said longitudinal axis from said plenum into said duct, said longitudinal axis and said central axis being substantially parallel.

Patentansprüche

1. Verfahren zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt, mit:

Erzeugen eines Volumens temperaturgeregelter Luft;
Liefern von temperaturgeregelter Luft im we-

sentlichen parallel zu einer Längsachse (125a; 325x) einer Luftabgabeeinrichtung, die einen länglichen Hohlkanal (125; 325) aufweist, der einen Innenraum hat und parallel zu der Längsachse (125a; 325x) angeordnet ist;
Abgeben eines Luftstroms aus dem Kanal (125; 325) auf das Nahrungsmittelprodukt in eine Richtung, die allgemein schräg zu der Längsachse (125a; 325x) verläuft; und
Hin- und Herschwenken des Kanals (125; 325) um eine Schwenkachse (142a; 325x), die parallel zu der Längsachse (125a; 325x) verläuft, wodurch der Luftstrom auf diskrete Bereiche der Oberfläche des Nahrungsmittelprodukts auftrifft, wenn der Kanal hin- und herschwenkt.

2. Verfahren zur Übertragung von Wärme nach Anspruch 1, bei dem der Schritt des Lieferns von temperaturgeregelter Luft im wesentlichen parallel zu einer Achse in einem Kanal die Schritte umfaßt:
Liefern von Luft durch ein Feld von Luftleitschaufeln (143), um die Luft entlang des Innenraums des länglichen Hohlkanals zu verteilen.

3. Verfahren zur Übertragung von Wärme nach Anspruch 1, bei dem der Schritt des Lieferns von temperaturgeregelter Luft im wesentlichen parallel zu einer Längsachse in einem Kanal die Schritte umfaßt:

Liefern von Luft durch ein rohrförmiges Bauteil (317); und
Anbringen des Kanals für ein Hin- und Herschwenken um das rohrförmige Bauteil.

4. Verfahren zur Übertragung von Wärme nach Anspruch 1, bei dem der Schritt des Lieferns von temperaturgeregelter Luft im wesentlichen parallel zu der Achse in einem Kanal die Schritte umfaßt:

Absaugen von verbrauchter Luft, die von dem Auftreffen des Stroms auf diskrete Bereiche auf der Oberfläche des Nahrungsmittelprodukts stammt, entlang eines Luftrückführweges;
Anordnen eines durchlässigen Bauteils (75; 275), das darin ausgebildete Durchgänge hat, wodurch verbrauchte Luft durch diese Durchgänge in dem durchlässigen Bauteil strömt, wobei das durchlässige Bauteil dazu ausgebildet ist, damit Schwebstoffe in der verbrauchten Luft durch das durchlässige Bauteil zurückgehalten werden.

5. Verfahren nach Anspruch 4, bei dem das durchlässige Bauteil eine herausnehmbare Spritzschutzplatte bildet, die sich über den Rückführweg erstreckt.

6. Verfahren zur Übertragung von Wärme nach einem der Ansprüche 1 bis 4, bei dem der längliche Hohlkanal mikrowellenreflektierende Flächen hat; und mit dem weiteren Schritt des Liefems von Mikrowellenenergie, so daß die Mikrowellenenergie durch die mikrowellenreflektierenden Flächen abgelenkt und verteilt wird.

7. Verfahren zur Übertragung von Wärme nach einem der Ansprüche 1 bis 4, bei dem Luft im wesentlichen parallel zu den Längsachsen (325x) von mehreren Luftabgabekanälen (325a, 325b) geliefert wird und jeder der Kanäle um beabstandete Schwenkachsen herum hin- und hergeschwenkt wird.

8. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt, mit:

einem Verteilerkanal (308), der eine Luftrückführöffnung (304) hat;
einem im wesentlichen kreisförmigen Auslaß (317) an dem Verteilerkanal (308), der eine mittlere Achse (325x) hat;
einem länglichen Kanal (325a, 325b) mit einer im wesentlichen kreisförmigen Einlaßöffnung (340) und einer Austrittsöffnung (328);
Einrichtungen (345-360), um den Kanal für eine Schwenkbewegung um die mittlere Achse (325x) zu halten; und
einem im wesentlichen kreisförmigen Kopplungselement (317, 340) mit einer Längsachse (325x), um die im wesentlichen kreisförmige Einlaßöffnung in dem Kanal in Fluidverbindung mit dem im wesentlichen kreisförmigen Auslaß (317) an dem Verteilerkanal zu bringen, wodurch Luft im wesentlichen parallel zu der Längsachse (325x) von dem Verteilerkanal (308) in den Kanal geliefert wird, wobei die mittlere Achse (325x) und die Längsachse (325x) im wesentlichen parallel verlaufen.

9. Vorrichtung zur Übertagung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 8, bei der das Kopplungselement aufweist:
eine Muffe (340), die dazu ausgestaltet ist, einen Bereich des im wesentlichen kreisförmigen Auslasses (317) zu umgeben.

10. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 8, bei der das Kopplungselement aufweist:
Einrichtungen, um Luft durch die Einlaßöffnung in eine Richtung zu liefern, die im wesentlichen parallel zu der Achse verläuft, um die der Kanal hin- und herschwenkt.

11. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 10, bei der die Austrittsöffnung (328) in dem Kanal (325) ausgestaltet ist, um einen Luftstrom abzugeben, die auf die Fläche eines Nahrungsmittelprodukts auftrifft.

12. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 8 bis 11, außerdem mit:

einem Feld von Luftleitflügeln (143) in dem länglichen Kanal, um Luft in dem länglichen Kanal zwischen der im wesentlichen kreisförmigen Einlaßöffnung und der Austrittsöffnung zu verteilen.

13. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 8 bis 11, bei der der längliche Kanal aufweist:

einen Körper mit einem sich verjüngenden Querschnitt, der zwischen beabstandeten Seitenwänden ausgebildet ist; und
eine Platte (326), die sich zwischen den beabstandeten Seitenwänden erstreckt, wobei die Austrittsöffnung (328) in der Platte ausgebildet ist.

14. Vorrichtung zur Übertagung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 13, bei der die Platte eine Anzahl beabstandeter Austrittsöffnungen hat; und

in dem länglichen Kanal benachbart zu der Platte (326) eine durchlöcherte Platte (343) vorgesehen ist, um in dem länglichen Kanal einen geringen Gegendruck zu bilden, um den Luftdruck längs des länglichen Kanals im wesentlichen gleichförmig zu halten.

15. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 13, bei der die durchlöcherte Platte ein Feld von Durchgängen (343a, 343b) aufweist, durch die Luft zu den Austrittsöffnungen (326) strömt.

16. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 8 bis 11, bei der die Einrichtungen, durch die der Kanal für eine Schwenkbewegung um die Achse gehalten ist, umfassen:

zumindest ein Querbauteil (345a, 345b), das an dem länglichen Kanal befestigt ist und sich über die Einlaßöffnung erstreckt; und
eine Welle (345), die an dem Querbauteil angebracht ist.

17. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 16, bei der die Einrichtungen, durch die der Kanal für eine Schwenkbewegung um die Achse gehalten ist, außerdem umfassen:

eine Verbindung (349), die für eine Hin- und Herbewegung mit der Welle verbunden ist, wobei eine Hin- und Herbewegung der Verbindung bewirkt, daß die Welle und der längliche Kanal um die Achse (325x) hin- und herschwenken.

18. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 8 bis 11, bei der der längliche Kanal eine mikrowellenreflektierende Fläche (326) hat, die um die Achse hin- und herschwenkt.

19. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 8 bis 11, bei der der längliche Kanal winkelig geneigte Flächen (326, 346) hat.

20. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 8 bis 11, zusätzlich mit einem durchlässigen Bauteil (275), das dazu ausgestaltet ist, das Durchtreten von Mikrowellenenergie entlang eines Luftrückführweges zur Rückführöffnung (304) in dem Verteilerkanal zu verhindern.

21. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 8 bis 11, bei der die Austrittsöffnung (328) aus dem länglichen Kanal (325a, 325b) in einer Düsenplatte (326) ausgebildet ist, die längs des Kanals verschiebbar ist, so daß sie zum Reinigen leicht herausgenommen werden kann.

22. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt, mit:

einem Schrank (270) mit einer inneren Raum; vorderen, seitlichen und hinteren Wänden (272-278) an dem Schrank, die sich um den inneren Raum herum erstrecken;
einer Verteilerkanalwand (316) in dem Raum, die eine Öffnung (304) hat, wobei durch die Verteilerkanalwand ein Verteilerkanal (308) in dem Raum gebildet ist;
einer von der Verteilerkanalwand beabstande-

ten Abtrenneinrichtung (275), durch die das Innere des Schrankes in eine Kochkammer (320) und eine Klimakammer (315) unterteilt ist;
einer Luftzirkulationseinrichtung (310), die Luft aus der Kochkammer ansaugt, um den Verteilerkanal mit Druck zu beaufschlagen;
einer Temperaturregelungseinrichtung (312) in der Klimakammer, um die Lufttemperatur in der Klimakammer zu regeln;
einer Luftabgabeeinrichtung (325), die eine Längsachse (325x) hat;
Einrichtungen (317, 340), durch die die Luftabgabeeinrichtung (325) so angebracht ist, daß Druckluft aus dem Verteilerkanal im wesentlichen parallel zu der Längsachse (325x) in die Luftabgabeeinrichtung geliefert wird, wobei beabstandete Luftströme schräg zu der Längsachse in Richtung auf ein Nahrungsmittelprodukt in der Kochkammer abgegeben werden; und
einer Einrichtung (360), um die Luftabgabeeinrichtung um eine Schwenkachse (325x) hin- und herzuschwenken, die parallel zu der Längsachse (325x) verläuft, um zu bewirken, daß sich die Luftströme über die Oberfläche des Nahrungsmittelproduktes bewegen.

23. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 22, bei der die Luftabgabeeinrichtung aufweist:

einen länglichen Kanal mit einem sich verjüngenden Querschnitt, der zwischen beabstandeten Seitenwänden ausgebildet ist; und
einer Platte (326), die sich zwischen den beabstandeten Seitenwänden erstreckt, wobei die Austrittsöffnung (328) in der Platte ausgebildet ist.

24. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 22, bei der die Luftabgabeeinrichtung aufweist:

erste und zweite längliche Kanäle mit mikrowellenreflektierenden Flächen, wobei jeder der Kanäle eine Einlaßöffnung und eine Austrittsöffnung hat, wobei die Einrichtung (360) zum Hin- und Herschwenken der Luftabgabeeinrichtung die Kanäle so bewegt, daß sich die mikrowellenreflektierenden Flächen von jedem der Kanäle bewegen, um Mikrowellenenergie in der Kochkammer zu verteilen.

25. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 22, bei der die Abtrenneinrichtung (275), die von der Verteilerkanalwand beabstandet ist und das Innere des Schrankes in eine Kochkammer (320) und eine Klimakammer (315) unterteilt, aufweist:

ein durchlässiges Bauteil (275) mit gebogenen Bereichen (75a, b, c), die ausgebildet sind, um an gegenüberliegenden Seiten der gebogenen Bereiche Durchgänge zu bilden, wobei Luftströme, die in eine erste Richtung im wesentlichen senkrecht zu dem durchlässigen Bauteil strömen, eine Anzahl von Luftströmen bilden, die allgemein parallel zu dem durchlässigen Bauteil strömen und die zusammenstoßen, um die Richtung in eine dritte Richtung zu ändern, die allgemein senkrecht zu dem durchlässigen Bauteil verläuft.

26. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 22 bis 25, bei der die Einrichtungen (317, 340), durch die die Luftabgabeeinrichtung gehalten ist, aufweist:

ein kreisförmiges Röhrenbauteil (317), das sich von der Verteilerkammerwand nach außen erstreckt; und
eine Muffeneinrichtung (340), die dazu ausgestaltet ist, um zusammenschiebbar einen Bereich des kreisförmigen Röhrenbauteils (317) aufzunehmen.

27. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 22 bis 25, bei der die Abtrenneinrichtung eine nichtleitende Beschichtung hat, um die Abtrenneinrichtung elektrisch zu isolieren.

28. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 22 bis 25, bei der die Abtrenneinrichtung einen mittleren Bereich und Randbereiche hat, die ausgestaltet sind, um einen Bereich der Kochkammer zu umschließen, so daß sich die Lufterwärmungskammer um einen Hauptbereich des Umfangs der Kochkammer erstreckt, wobei Luft aus der Kochkammer entlang mehrerer Wege zu den Seitenwänden und zu der hinteren Wand gesaugt wird.

29. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 22 bis 25, bei der die Abtrenneinrichtung aufweist:

eine Platte mit Bereichen, die in entgegengesetzten Richtungen von der Ebene der Platte nach außen gebogen sind, um Durchgänge zu bilden, durch die Luft in eine Richtung strömt, die allgemein parallel zu der Ebene der Platte verläuft, während Luft blockiert wird, die in eine Richtung strömt, die allgemein senkrecht zu der Ebene der Platte ver-

läuft.

30. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 22 bis 25, bei der die Luftabgabeeinrichtung aufweist:

eine Anzahl von Luftabgabekanälen; und eine Antriebseinrichtung, um jeden der Luftabgabekanäle in der Heizkammer hin- und herzuschwenken.

31. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 30, bei der die Antriebseinrichtung zum Hin- und Herschwenken von jedem der Luftabgabekanäle aufweist:

einen Motor;
ein durch den Motor angetriebenes Antriebsbauteil; und
eine Anzahl von Verbindungen, die sich zwischen dem Antriebsbauteil und den Luftabgabekanälen erstrecken.

32. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach einem der Ansprüche 22 bis 25, die außerdem aufweist:

eine Mikrowellenheizeinrichtung, die mit der Kochkammer in Verbindung steht, wobei durch die Abtrenneinrichtung eine Übertragung von Mikrowellenenergie von der Kochkammer in die Klimakammer verhindert wird.

33. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 30, mit einer zusätzlichen Antriebseinrichtung, die mit jedem der Luftabgabekanäle verbunden ist, um zu bewirken, daß sich die Kanäle im Gleichtakt bewegen.

34. Vorrichtung zur Übertragung von Wärme zwischen temperaturgeregelter Luft und einem Nahrungsmittelprodukt nach Anspruch 22, bei der die Einrichtung, durch die Luftabgabeeinrichtung montiert ist, aufweist:

einen im wesentlichen kreisförmigen Auslaß an dem Verteilerkanal, der eine mittlere Achse hat;
einen länglichen Kanal mit einer im wesentlichen kreisförmigen Einlaßöffnung und einer Austrittsöffnung;
eine Einrichtung, durch die der Kanal für ein Hin- und Herschwenken um die mittlere Achse gehalten ist; und
ein im wesentlichen kreisförmiges Kopplungselement mit einer Längsachse, um die im wesentlichen kreisförmige Einlaßöffnung in dem Kanal in Fluidverbindung mit dem im wesentlichen kreisförmigen Auslaß an dem Verteilerkanal zu bringen, wodurch Luft im wesentlichen parallel zu der Längsachse von dem Verteilerkanal in den Kanal geliefert wird, wobei die Längsachse und die mittlere Achse im wesentlichen parallel sind.

Revendications

1. Procédé de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire, consistant à :

prévoir un volume d'air à température contrôlée ;
délivrer de l'air à température contrôlée, sensiblement parallèlement à l'axe longitudinal (125a, 325x) de moyens de distribution d'air qui comprennent un conduit creux allongé (125 ; 325) comportant un espace intérieur et disposé parallèlement audit axe longitudinal (125a ; 325x) ;
distribuer un courant d'air à partir dudit conduit (125 ; 325) en direction de la denrée alimentaire dans une direction sensiblement transversale audit axe longitudinal (125a ; 325x) ; et
déplacer en va-et-vient ledit conduit (125 ; 325) autour d'un axe de déplacement en va-et-vient (142a ; 325x), qui est parallèle audit axe longitudinal (125a ; 325x), ce qui a pour effet que ledit courant d'air rencontre des zones discrètes de la surface de la denrée alimentaire lorsque ledit conduit se déplace en va-et-vient.

2. Procédé de transfert de chaleur selon la revendication 1, l'étape de délivrance d'air à température contrôlée, sensiblement parallèlement à un axe, dans un conduit, comprenant les étapes consistant à :

délivrer de l'air à travers un réseau d'aubes (143) de guidage de l'air, pour distribuer l'air le long de l'espace intérieur du conduit creux allongé.

3. Procédé de transfert de chaleur selon la revendication 1, l'étape de délivrance d'air à température contrôlée, sensiblement parallèlement à un axe longitudinal, dans un conduit comprenant les étapes consistant à :

délivrer de l'air par l'intermédiaire d'un élément tubulaire (317) ; et
monter ledit conduit de manière qu'il exécute un déplacement en va-et-vient autour dudit élément tubulaire.

4. Procédé de transfert de chaleur selon la revendication 1, l'étape de délivrance d'air à température contrôlée, sensiblement parallèlement audit axe, dans

un conduit, comprenant les étapes consistant à :

soutirer de l'air utilisé, provenant d'un impact dudit courant sur des zones discrètes de la surface de la denrée alimentaire, le long d'un trajet de retour de l'air ;
positionner un élément perforé (75 ; 275) dans lequel sont formés des passages, ce qui permet audit air utilisé de traverser lesdits passages formés dans ledit élément perforé, ledit élément perforé étant configuré de telle sorte que des particules véhiculées par l'air et contenues dans ledit air utilisé sont retenues par ledit élément perforé.

5. Procédé selon la revendication 4, selon lequel ledit élément perforé constitue un écran amovible de protection contre les éclaboussures, qui s'étend en travers dudit trajet de retour.

6. Procédé de transfert de chaleur selon l'une quelconque des revendications 1 à 4, selon lequel ledit conduit creux allongé comporte des surfaces réfléchissant les micro-ondes ; et avec l'addition de l'étape consistant à délivrer une énergie à micro-ondes de telle sorte que lesdites surfaces réfléchissant les micro-ondes agitent et distribuent l'énergie à micro-ondes.

7. Procédé de transfert de chaleur selon l'une quelconque des revendications 1 à 4, dans lequel de l'air est délivré sensiblement parallèlement à des axes longitudinaux (325x) de multiples conduits de distribution d'air (325a, 325b) et avec déplacement en va-et-vient de chacun desdits conduits autour d'axes espacés de déplacement en va-et-vient.

8. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire, comprenant :

une enceinte (308) comportant une ouverture de retour d'air (304) ;
une sortie sensiblement circulaire (317) située sur ladite enceinte (308) et comportant un axe central (325x) ;
un conduit allongé (325a, 325b) possédant une ouverture d'entrée sensiblement circulaire (340) et une ouverture de sortie (328) ;
des moyens (345-360) supportant ledit conduit pour permettre un déplacement en va-et-vient autour dudit axe central (325x) ; et
un dispositif d'accouplement sensiblement circulaire (317, 340) possédant un axe longitudinal (325x) pour placer ladite ouverture d'entrée sensiblement circulaire dans ledit conduit en communication fluidique avec ladite sortie sensiblement circulaire (317) formée sur ladite enceinte, ce qui a pour effet que de l'air est délivré sensiblement parallèlement audit axe longitudinal (325x) depuis ladite enceinte (308) dans ledit conduit, ledit axe central (325x) et ledit axe longitudinal (325x) étant sensiblement parallèles.

9. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire selon la revendication 8, ledit dispositif d'accouplement comprenant :
un manchon (340) conformé de manière à entourer une partie de ladite sortie sensiblement circulaire (317).

10. Dispositif de transfert de chaleur entre un air à température contrôlée, et une denrée alimentaire conformément à la revendication 8, ledit dispositif d'accouplement comprenant :
des moyens délivrant de l'air par l'intermédiaire de ladite ouverture d'entrée dans une direction sensiblement parallèlement audit axe autour duquel ledit conduit se déplace en va-et-vient.

11. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire, selon la revendication 10, ladite ouverture de sortie (328) dudit conduit (325) étant conformée de manière à distribuer un courant d'air venant frapper la surface d'une denrée alimentaire.

12. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire, selon l'une quelconque des revendications 8 à 11, avec addition de :
un réseau d'aubes (143) de guidage de l'air situées dans ledit conduit allongé pour distribuer de l'air dans ledit conduit allongé entre ladite ouverture d'entrée sensiblement circulaire et ladite ouverture de sortie.

13. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 8 à 11, ledit conduit allongé comprenant :

une partie formant corps possédant une section transversale convergente formée entre des parois latérales espacées ; et
une plaque (326) qui s'étend entre lesdites parois latérales espacées, ladite ouverture de sortie (328) étant formée dans ladite plaque.

14. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire selon la revendication 13, ladite plaque possédant une pluralité d'ouvertures de sortie espacées ; et
une plaque perforée (343) située dans ledit

conduit allongé au voisinage de ladite plaque (326) de manière à former une légère contre-pression dans ledit conduit allongé afin de maintenir une pression d'air sensiblement uniforme dans la direction longitudinale dudit conduit allongé.

15. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire selon la revendication 13, ladite plaque perforée possédant un réseau de passages (343a, 343b) par lesquels de l'air pénètre dans lesdites ouvertures de sortie (326).

16. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 8 à 11, lesdits moyens supportant ledit conduit pour un déplacement en va-et-vient autour dudit axe comprenant :

au moins un élément transversal (345a, 345b) fixé audit conduit allongé et s'étendant en travers de ladite ouverture d'entrée ; et
un arbre (345) fixé audit élément transversal.

17. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon la revendication 16, lesdits moyens supportant ledit conduit pour un déplacement en va-et-vient autour dudit axe comprenant en outre :

une bielle (349) montée de manière à exécuter un déplacement en va-et-vient et connecté audit arbre, ce qui a pour effet que le déplacement en va-et-vient de ladite bielle fait osciller ledit arbre et ledit conduit allongé autour dudit axe (325x).

18. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 8 à 11, ledit conduit allongé possédant une surface (326) réfléchissante pour les micro-ondes et qui se déplace en va-et-vient autour dudit axe.

19. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une durée alimentaire selon l'une quelconque des revendications 8 à 11, ledit conduit allongé possédant des surfaces inclinées angulairement (326, 346).

20. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 8 à 11, avec l'addition d'un élément perforé (275) formé de manière à empêcher le passage d'une énergie à micro-ondes le long d'un trajet de retour de l'air en direction de ladite ouverture de retour (304) de ladite enceinte.

21. Dispositif de transfert de chaleur entre l'air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 8 à 11, ladite ouverture de sortie (328) dudit conduit allongé (325a, 325b) étant formée dans une plaque à jets (326) pouvant glisser dans la direction longitudinale dudit conduit de telle sorte qu'elle peut être aisément retirée pour son nettoyage.

22. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire, comprenant :

un coffret (270) possédant un compartiment intérieur ;
des parois avant, latérales et arrière (272-278) dudit coffret, s'étendant autour dudit compartiment ;
une paroi d'enceinte (316) située dans ledit compartiment et possédant une ouverture (304), ladite paroi d'enceinte formant une enceinte (308) dans ledit compartiment ;
des moyens de séparation (275) distants de ladite paroi d'enceinte et divisant l'intérieur du coffretenune chambre de cuisson (320) et une chambre de conditionnement d'air (315) ;
des moyens de circulation d'air (310) prélevant de l'air depuis ladite chambre de cuisson pour la mise en pression de ladite enceinte ;
des moyens de contrôle de température (312) situés dans ladite chambre de conditionnement d'air pour contrôler la température de l'air dans ladite chambre de conditionnement d'air ;
des moyens formant distributeur d'air (325) possédant un axe longitudinal (325x) ;
des moyens (317, 340) supportant lesdits moyens formant distributeur d'air (325) de sorte que ledit air comprimé provenant de ladite enceinte est délivré sensiblement parallèlement audit axe longitudinal (325x) dans lesdits moyens formant distributeur d'air, et que de ce fait des courants d'air espacés sont distribués transversalement par rapport audit axe longitudinal en direction d'une durée alimentaire située dans ledit compartiment de cuisson ; et
des moyens (360) pour déplacer en va-et-vient lesdits moyens formant distributeur d'air autour d'un axe de déplacement en va-et-vient (325x) qui est parallèle audit axe longitudinal (325x) pour amener lesdits courants d'air à balayer la surface de la denrée alimentaire.

23. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon la revendication 22, dans lequel lesdits moyens formant distributeur d'air comprennent :

un conduit allongé possédant une section transversale convergente formée entre des pa-

rois latérales espacées ; et
une plaque (326) s'étendant entre lesdites parois latérales espacées, ladite ouverture de sortie (328) étant formée dans ladite plaque.

24. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon la revendication 22, lesdits moyens formant distributeur d'air comprenant :

des premier et second conduits allongés ayant des surfaces réfléchissantes pour les micro-ondes et chacun desdits conduits possédant une ouverture d'entrée et une ouverture de sortie, lesdits moyens (360) pour déplacer en va-et-vient lesdits moyens formant distributeur d'air déplaçant lesdits conduits de telle sorte que lesdites surfaces réfléchissant les micro-ondes de chacun desdits conduits se déplacent pour distribuer une énergie à micro-ondes dans le compartiment de cuisson.

25. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon la revendication 22, lesdits moyens de séparation (275) espacés de ladite paroi d'enceinte divisant l'intérieur du coffret en une chambre de cuisson (320) et une chambre de conditionnement d'air (315) comprenant :

un élément perforé (275) comportant des parties déviées (75a, b, c) formées de manière à constituer des passages sur des côtés opposés desdites parties déviées, des courants d'air circulant dans une première direction sensiblement perpendiculaire audit élément perforé formant une pluralité de courants d'air circulant sensiblement parallèlement audit élément perforé, qui se rencontrent pour commuter la direction sur ladite troisième direction sensiblement perpendiculaire audit élément perforé.

26. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 22 à 25, lesdits moyens (317, 340) supportant lesdits moyens formant distributeur d'air comprenant :

un élément tubulaire circulaire (317) qui s'étend vers l'extérieur à partir de ladite paroi d'enceinte ; et
des moyens formant manchon (340) configurés de manière à recevoir de façon télescopique une partie dudit élément tubulaire circulaire (317).

27. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 22 à 25, lesdits moyens de séparation possédant un revêtement non conducteur servant à isoler électriquement lesdits moyens de séparation.

28. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 22 à 25, lesdits moyens de séparation possédant une partie centrale et des extrémités conformées de manière à entourer une partie de ladite chambre de cuisson de telle sorte que ladite chambre de chauffage de l'air s'étend autour d'une partie principale de la périphérie de la chambre de cuisson, de l'air étant entraîné le long de trajets multiples en direction desdites parois latérales et en direction de ladite paroi arrière à partir de ladite chambre de cuisson.

29. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 22 à 25, lesdits moyens de séparation comprenant :

une feuille dont certaines parties sont déviées vers l'extérieur dans des directions opposées à partir du plan de la feuille pour former des passages, dans lesquels de l'air circule dans une direction sensiblement parallèle au plan de la feuille, tout en bloquant le courant d'air dans une direction sensiblement perpendiculaire au plan de la feuille.

30. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 22 à 25, ledit distributeur d'air comprenant :

une pluralité de conduits de distribution d'air ; et des moyens d'entraînement pour déplacer en va-et-vient chacun des conduits de distribution d'air dans ladite chambre de chauffage.

31. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon la revendication 30, lesdits moyens d'entraînement pour déplacer en va-et-vient lesdits conduits de distribution d'air comprenant :

un moteur ;
un organe d'entraînement entraîné par ledit moteur ; et
une pluralité d'éléments de liaison s'étendant entre ledit élément de commande et lesdits conduits de distribution d'air.

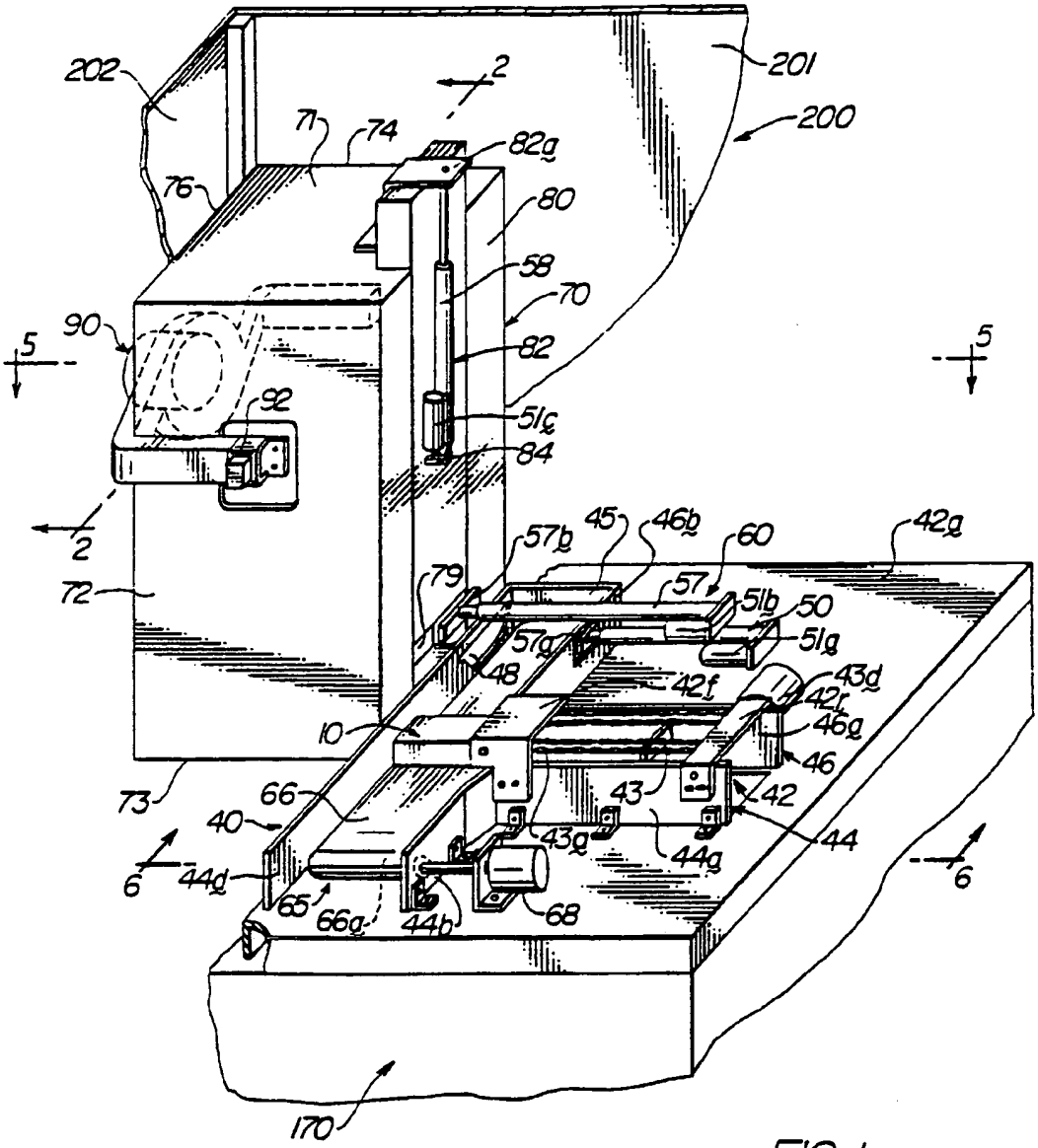
32. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire selon l'une quelconque des revendications 22 à 25, avec l'addition de :

des moyens de chauffage à micro-ondes communiquant avec ladite chambre de cuisson, lesdits moyens de séparation empêchant un transfert de l'énergie à micro-ondes depuis ladite chambre de cuisson à ladite chambre de conditionnement d'air.

33. Dispositif de transfert de chaleur entre de l'air à température contrôlée et une denrée alimentaire selon la revendication 30, comportant des moyens additionnels d'entraînement raccordés à chacun desdits moyens de distribution d'air pour amener lesdits conduits à se déplacer de concert.

34. Dispositif de transfert de chaleur entre un air à température contrôlée et une denrée alimentaire selon la revendication 22, lesdits moyens de support des moyens de distribution d'air comprenant :

une sortie sensiblement circulaire formée sur ladite enceinte et possédant un axe central ;
un conduit allongé possédant une ouverture d'entrée sensiblement circulaire et une ouverture de sortie ;
des moyens supportant ledit conduit pour permettre son déplacement en va-et-vient autour dudit axe central ; et
un dispositif d'accouplement sensiblement circulaire possédant un axe longitudinal pour placer Ladite ouverture d'entrée sensiblement circulaire présente dans ledit conduit en communication fluidique avec ladite sortie sensiblement circulaire formée dans ladite enceinte, ce qui a pour effet que de l'air est délivré sensiblement parallèlement audit axe longitudinal depuis ladite enceinte dans ledit conduit, ledit axe longitudinal et ledit axe central étant sensiblement parallèles.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51a
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FIG. 1

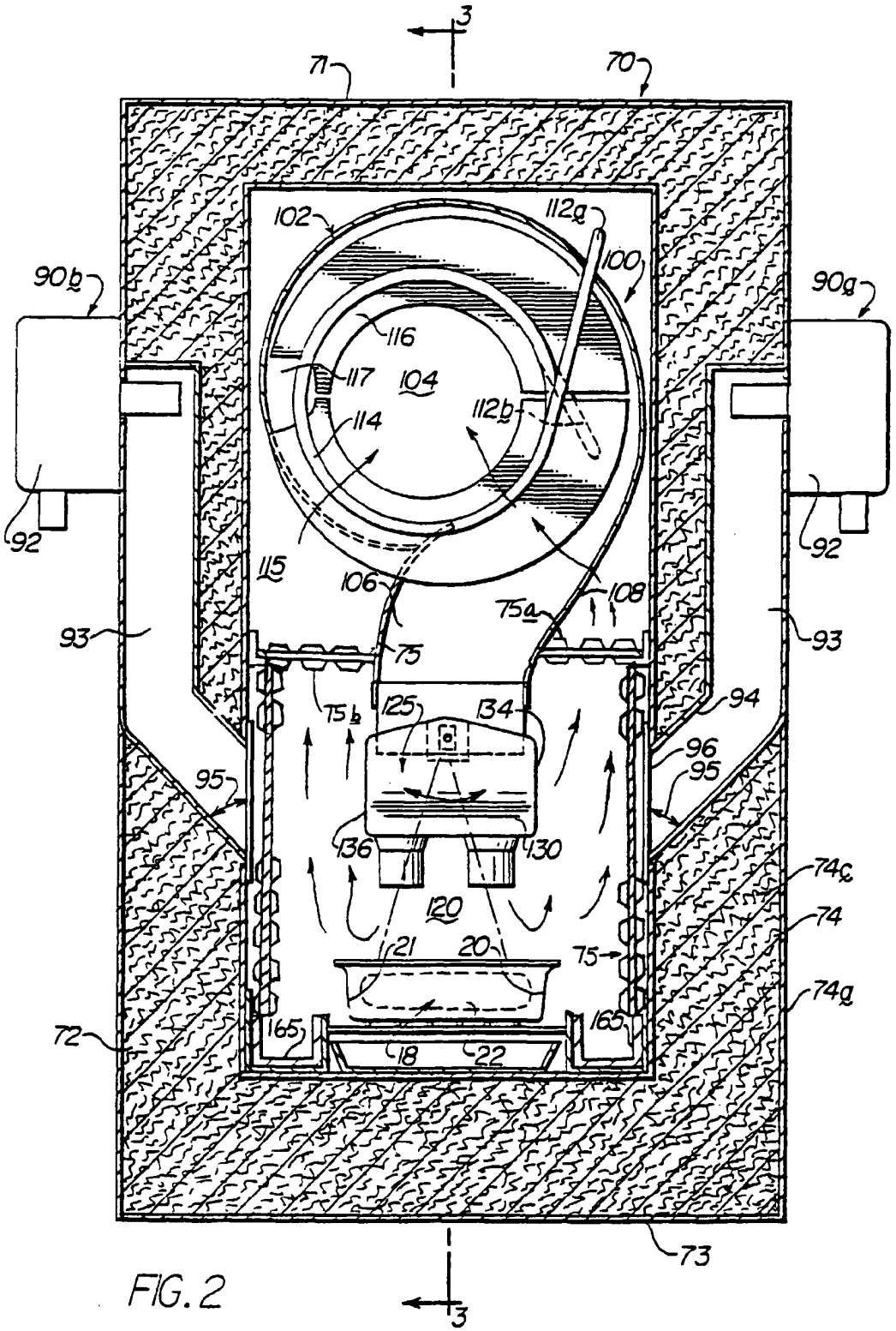
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FIG. 2

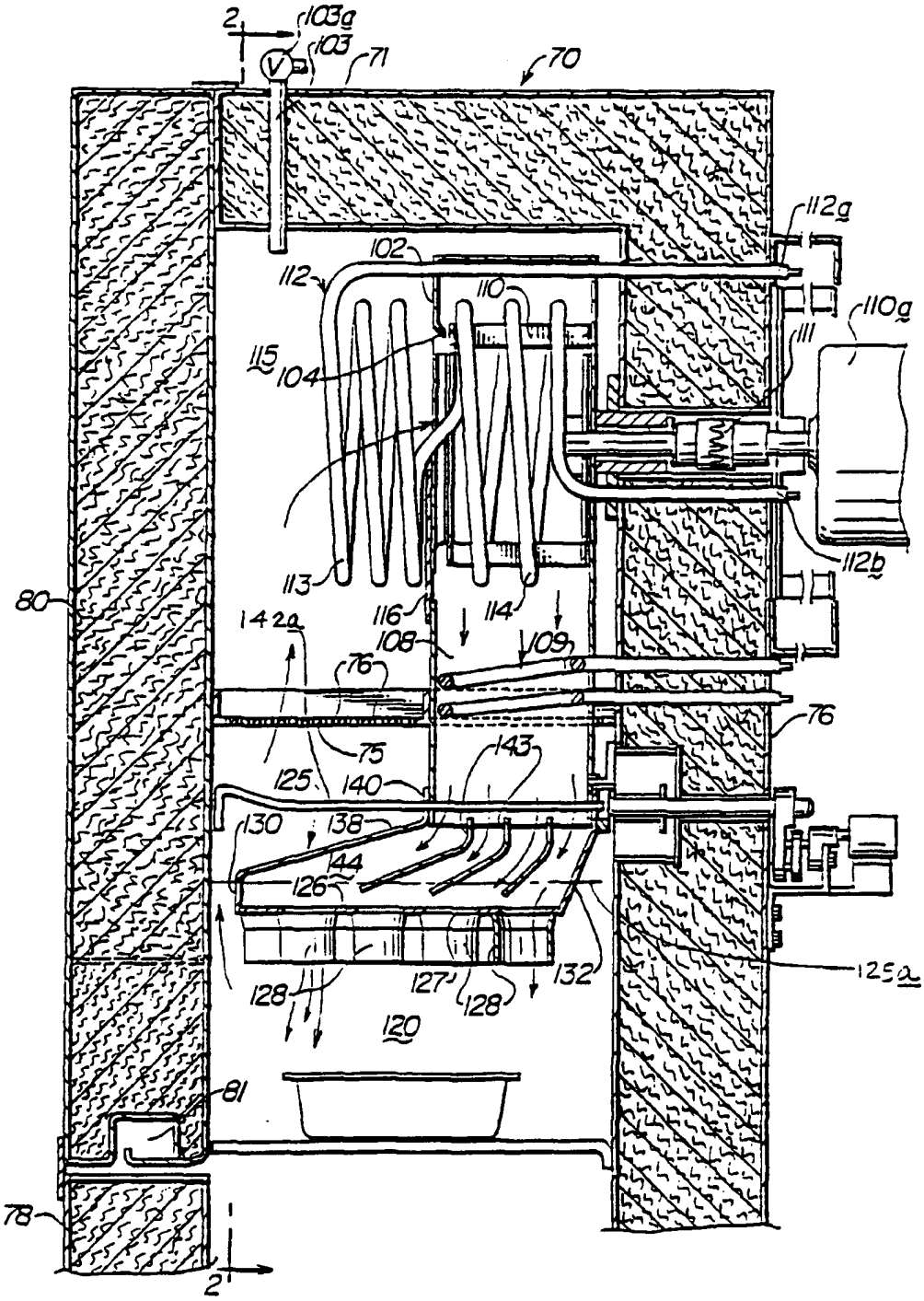
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FIG. 3

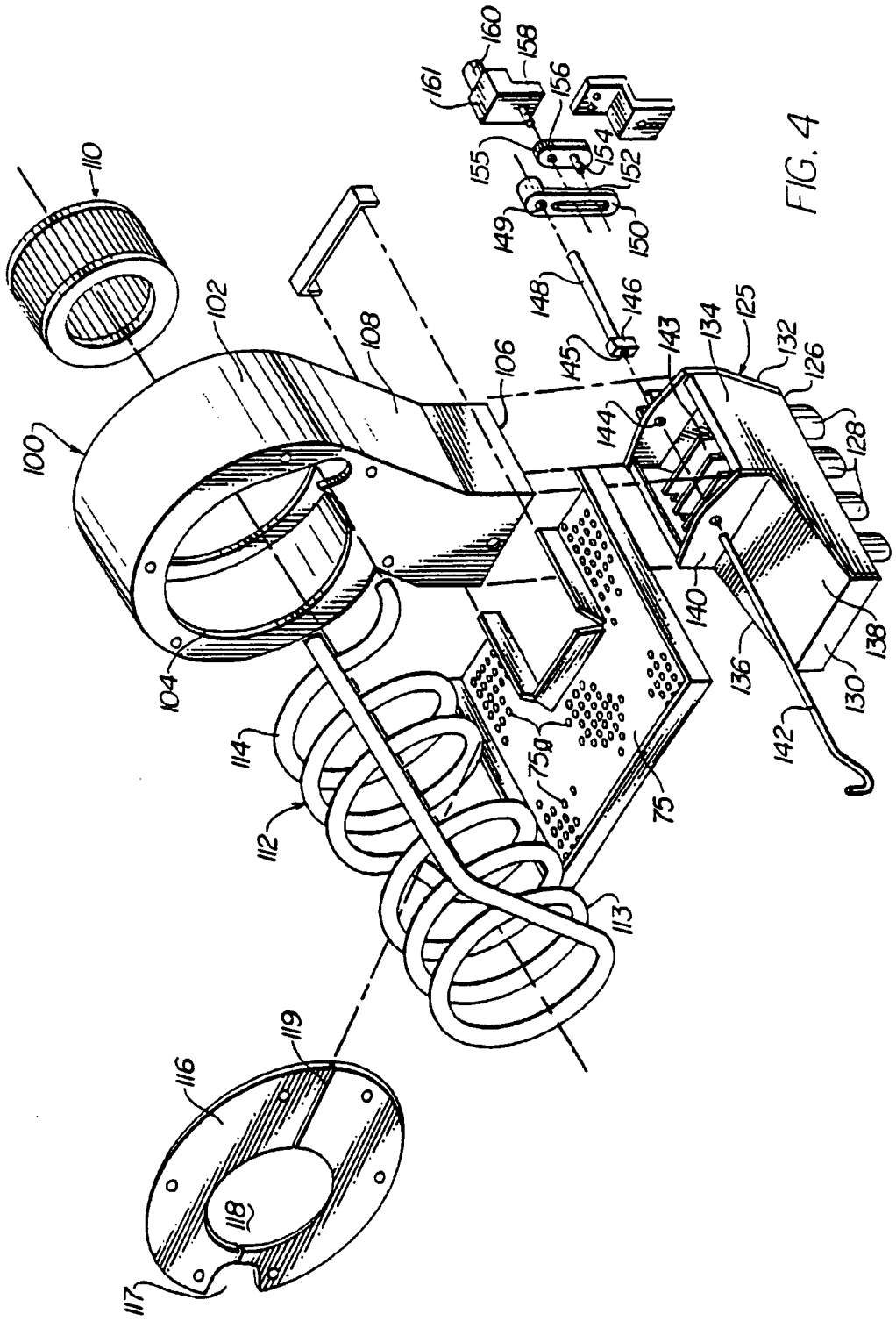
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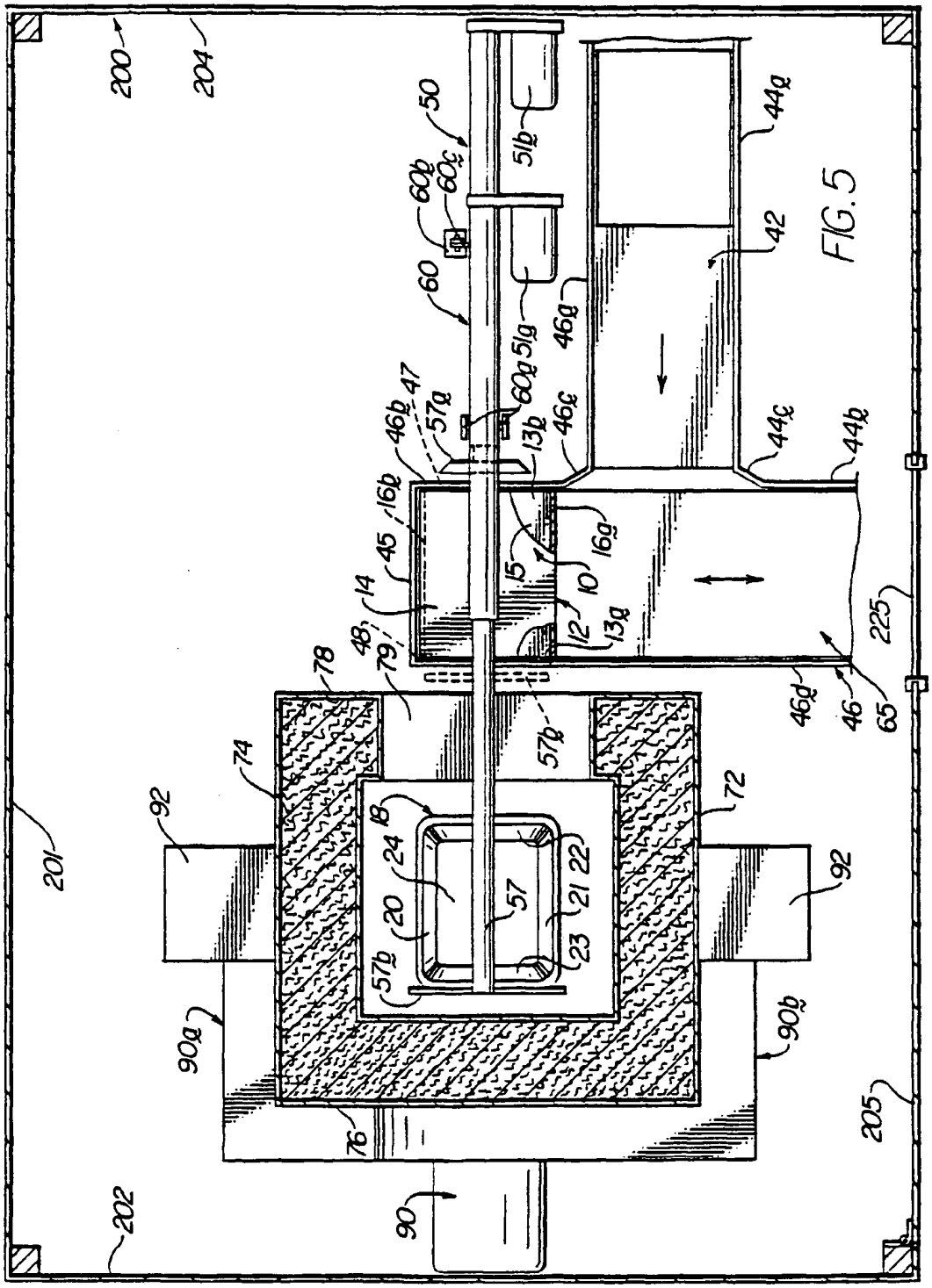
FIG. 4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14
48
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16g
12
13g
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46d
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FIG. 5

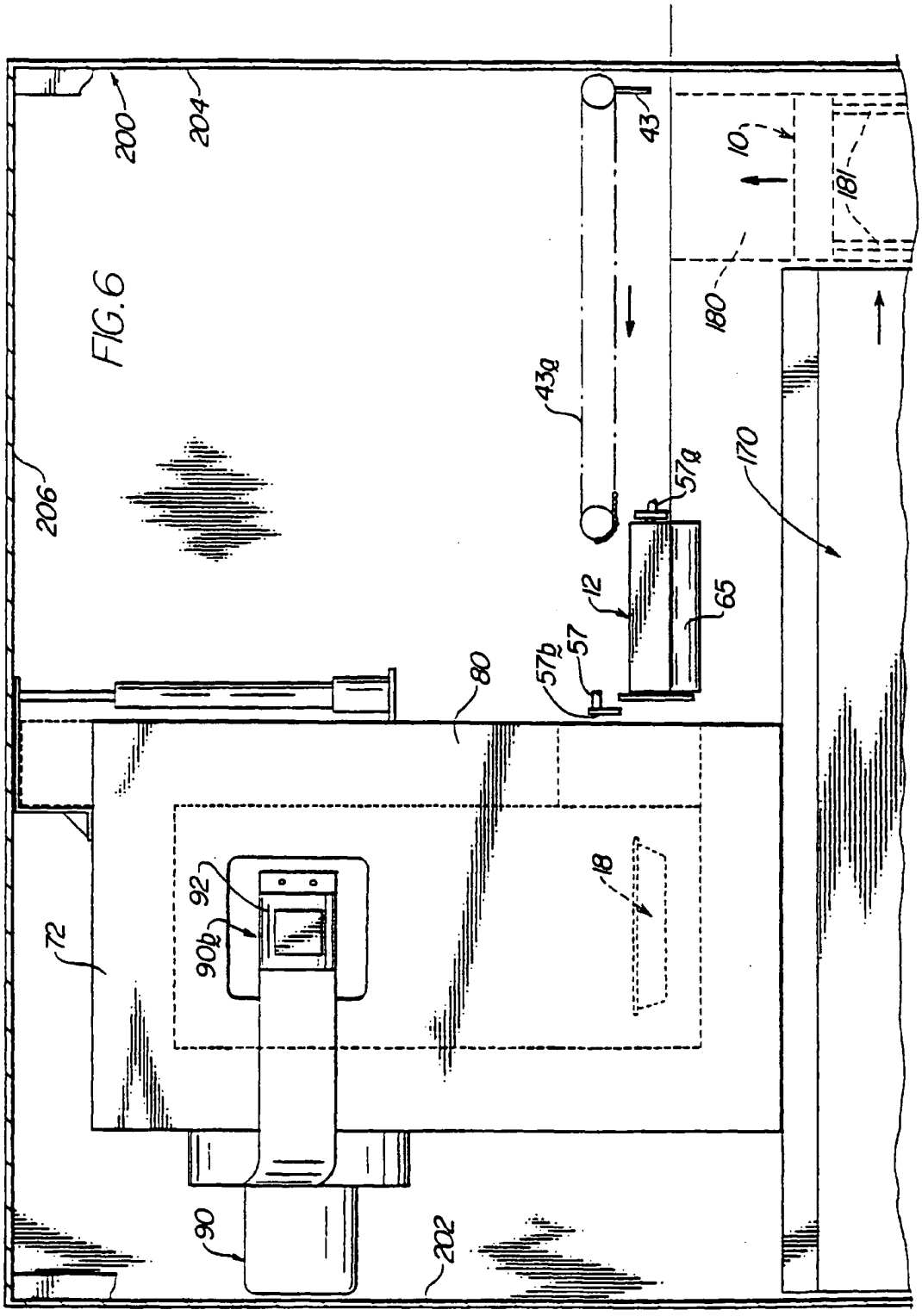
FIG.6
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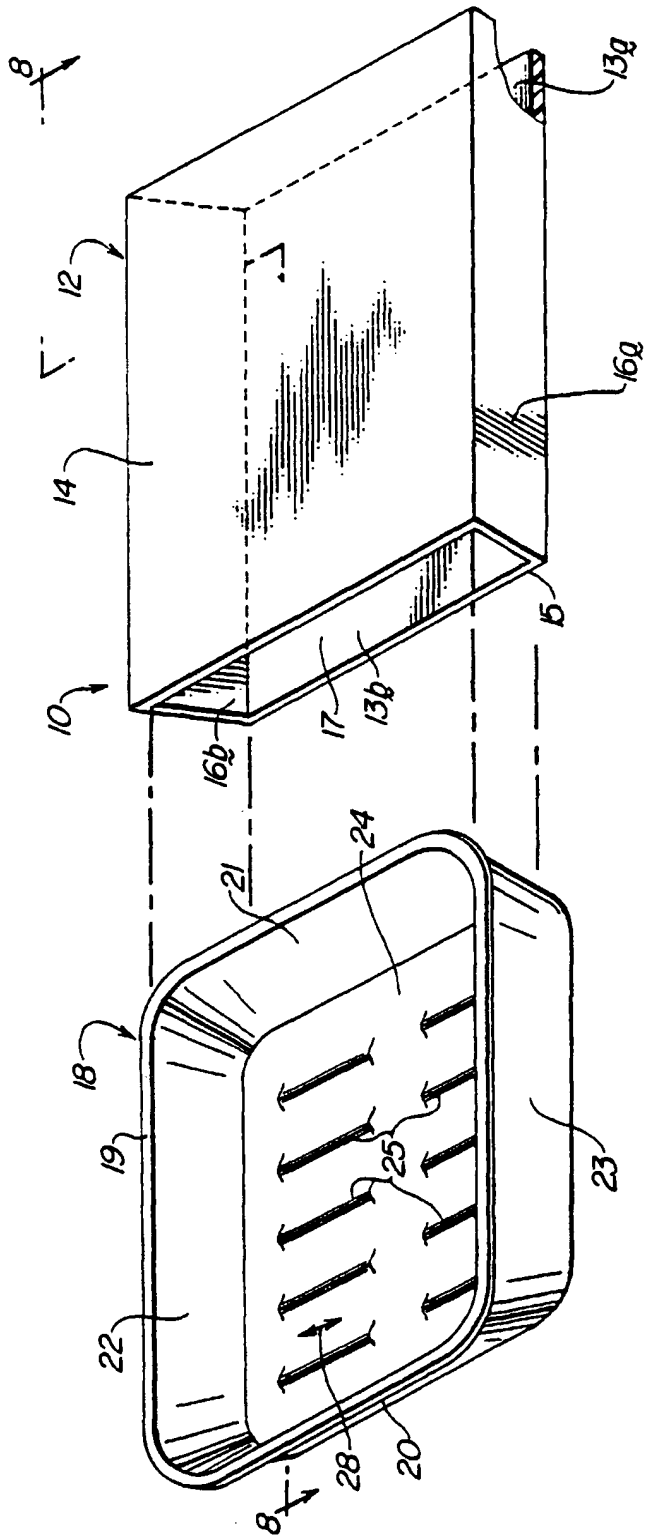

FIG. 7

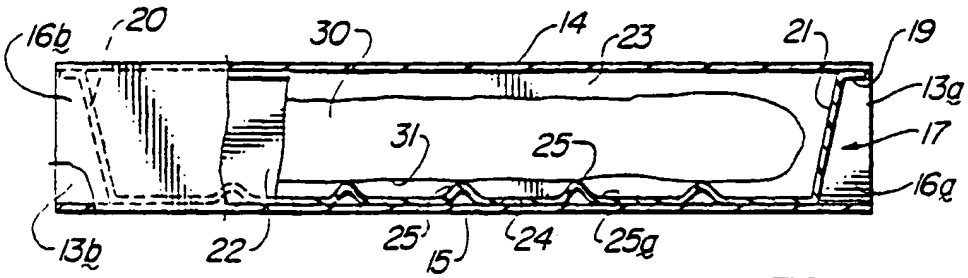

FIG. 8

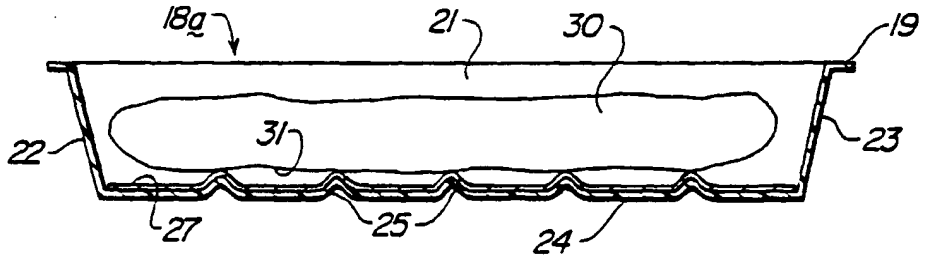

FIG. 9

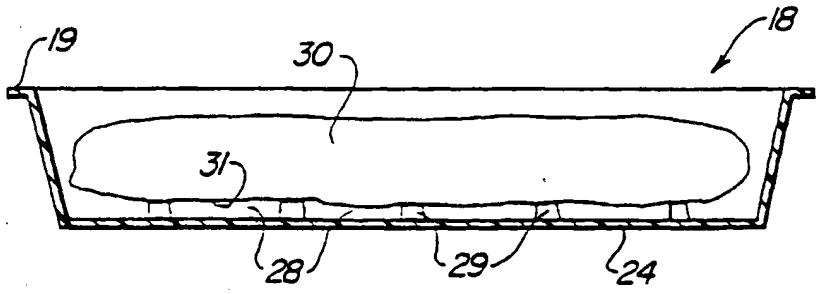

FIG. 10

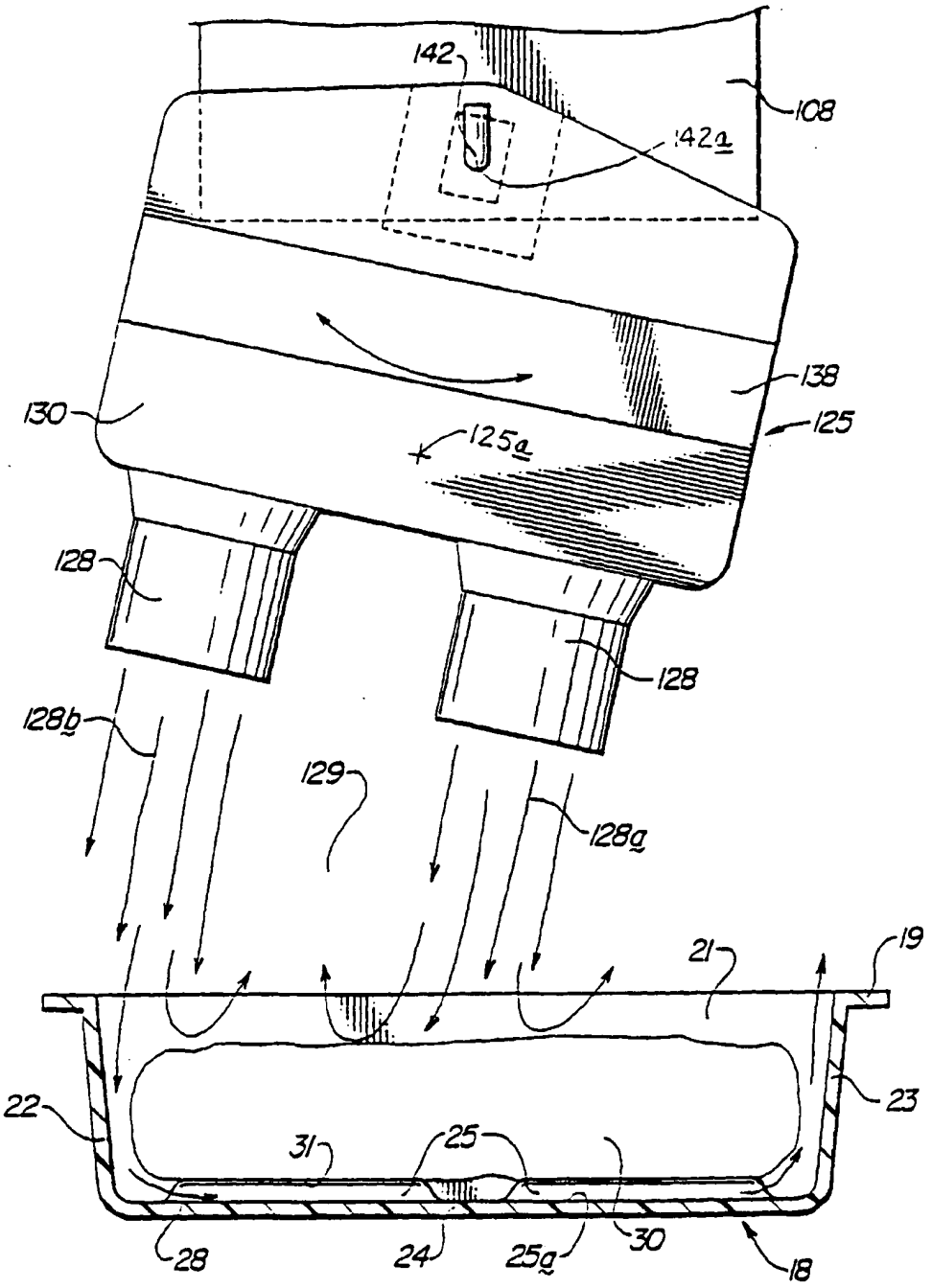
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FIG. 11

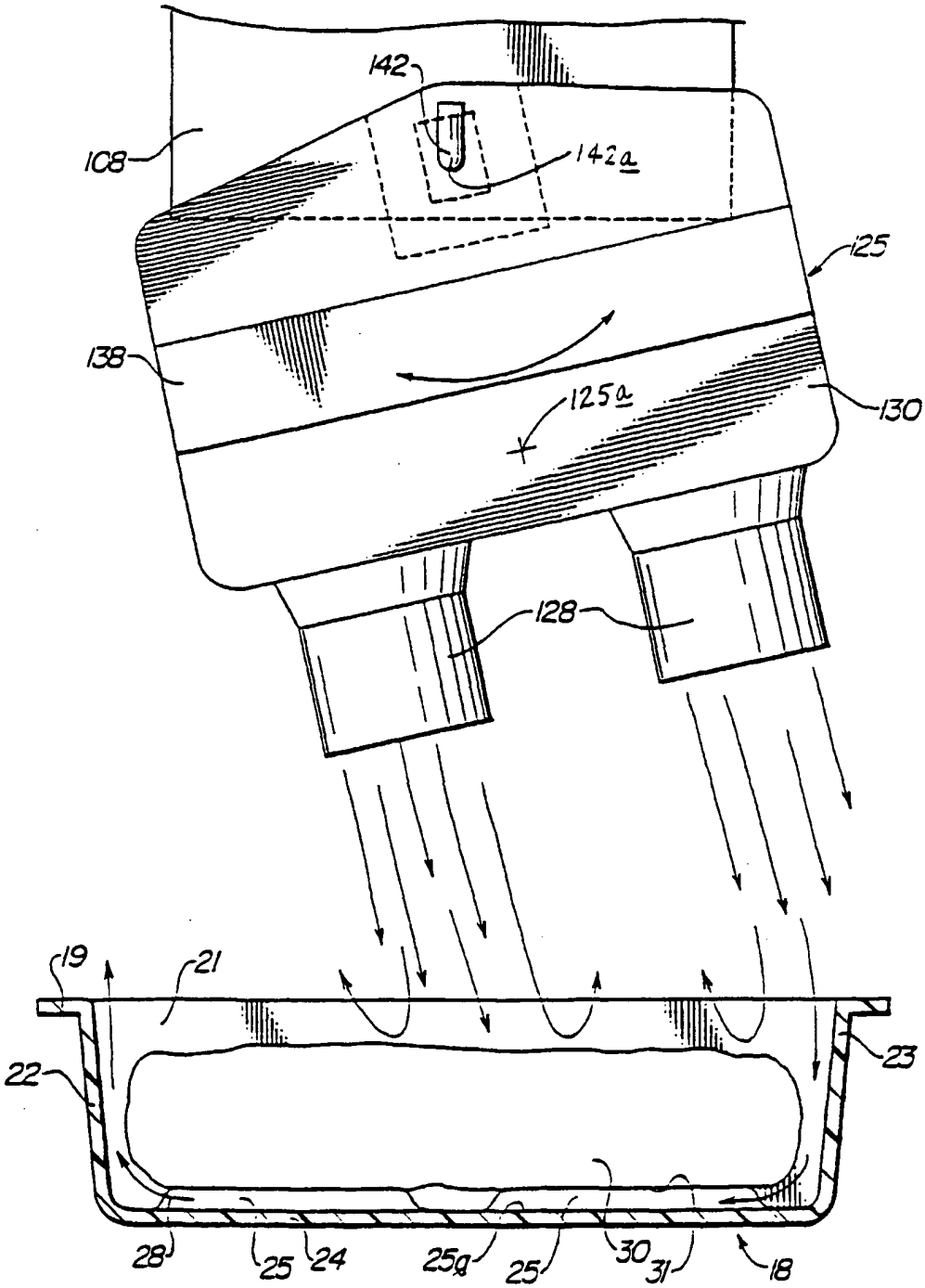
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FIG. 12

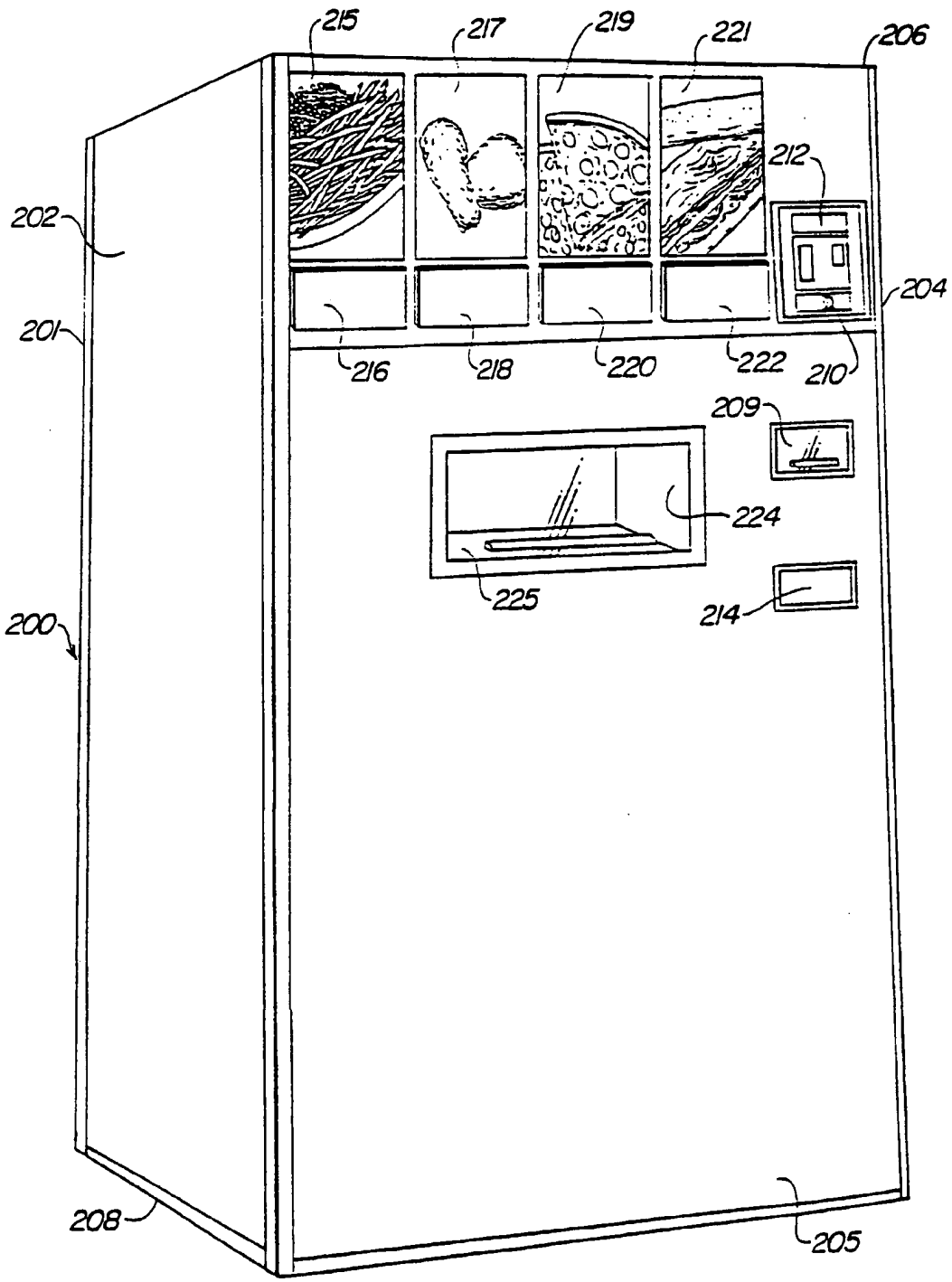
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FIG. 13

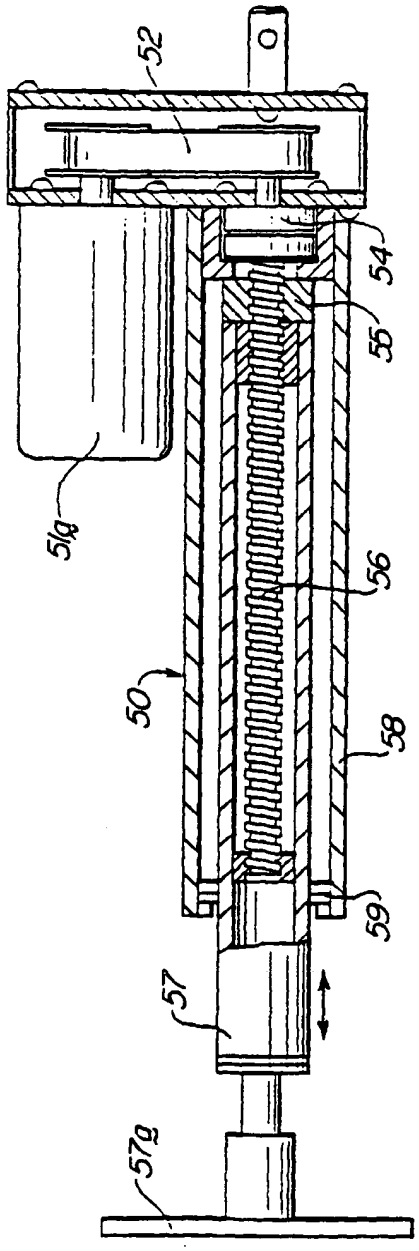

FIG. 14

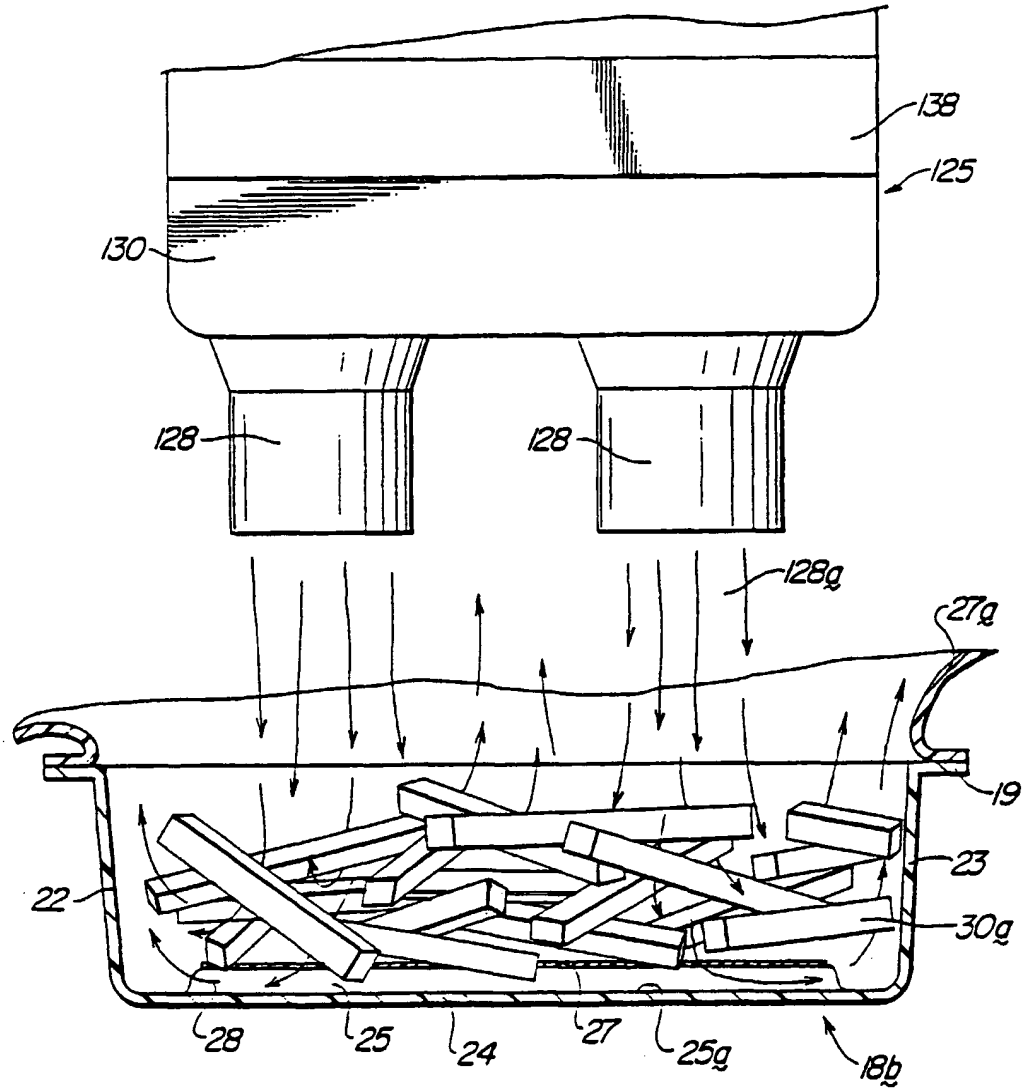

FIG. 15

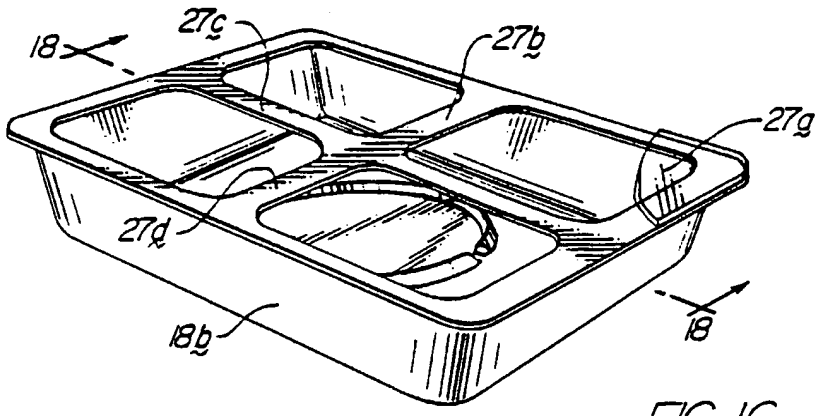

FIG. 16

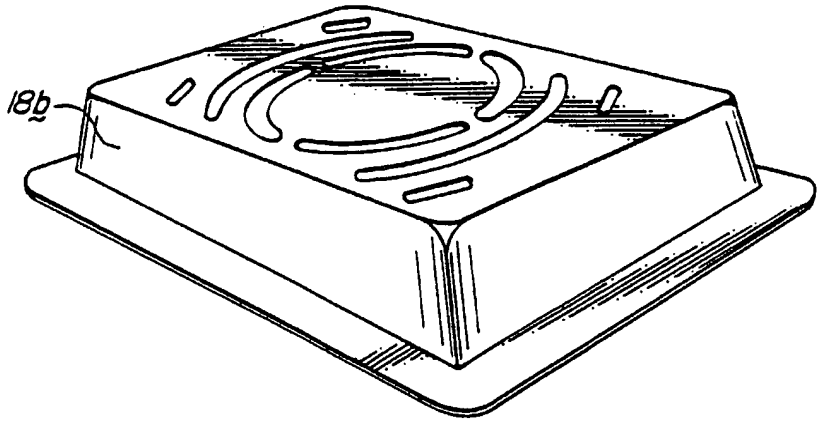

FIG. 17

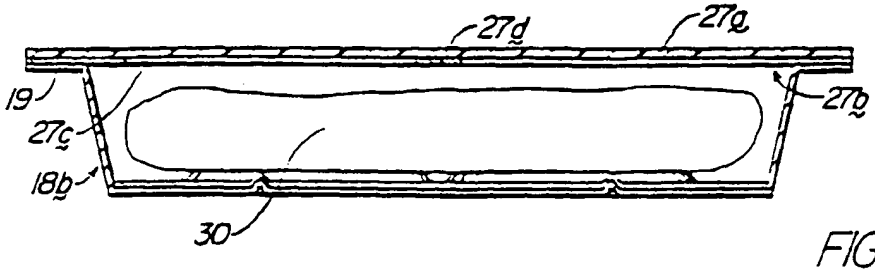

FIG. 18

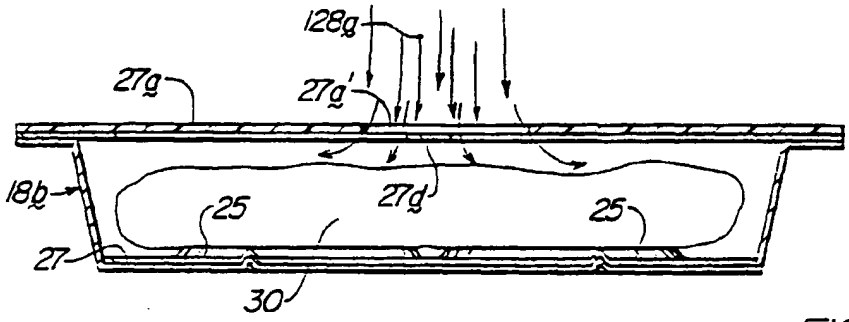

FIG. 19

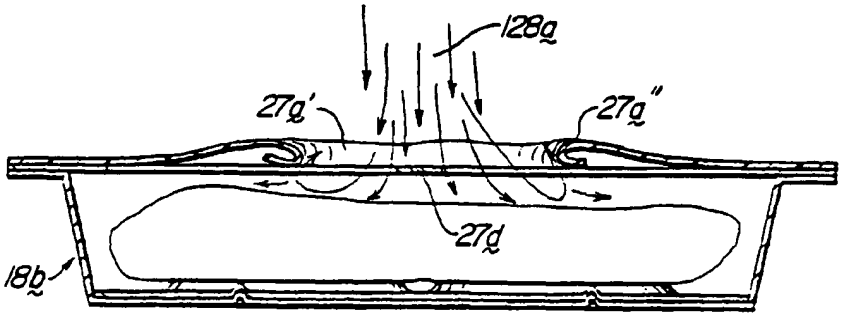

FIG. 20

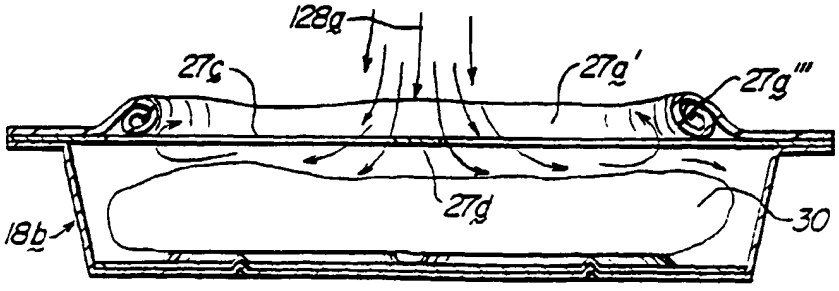

FIG. 21

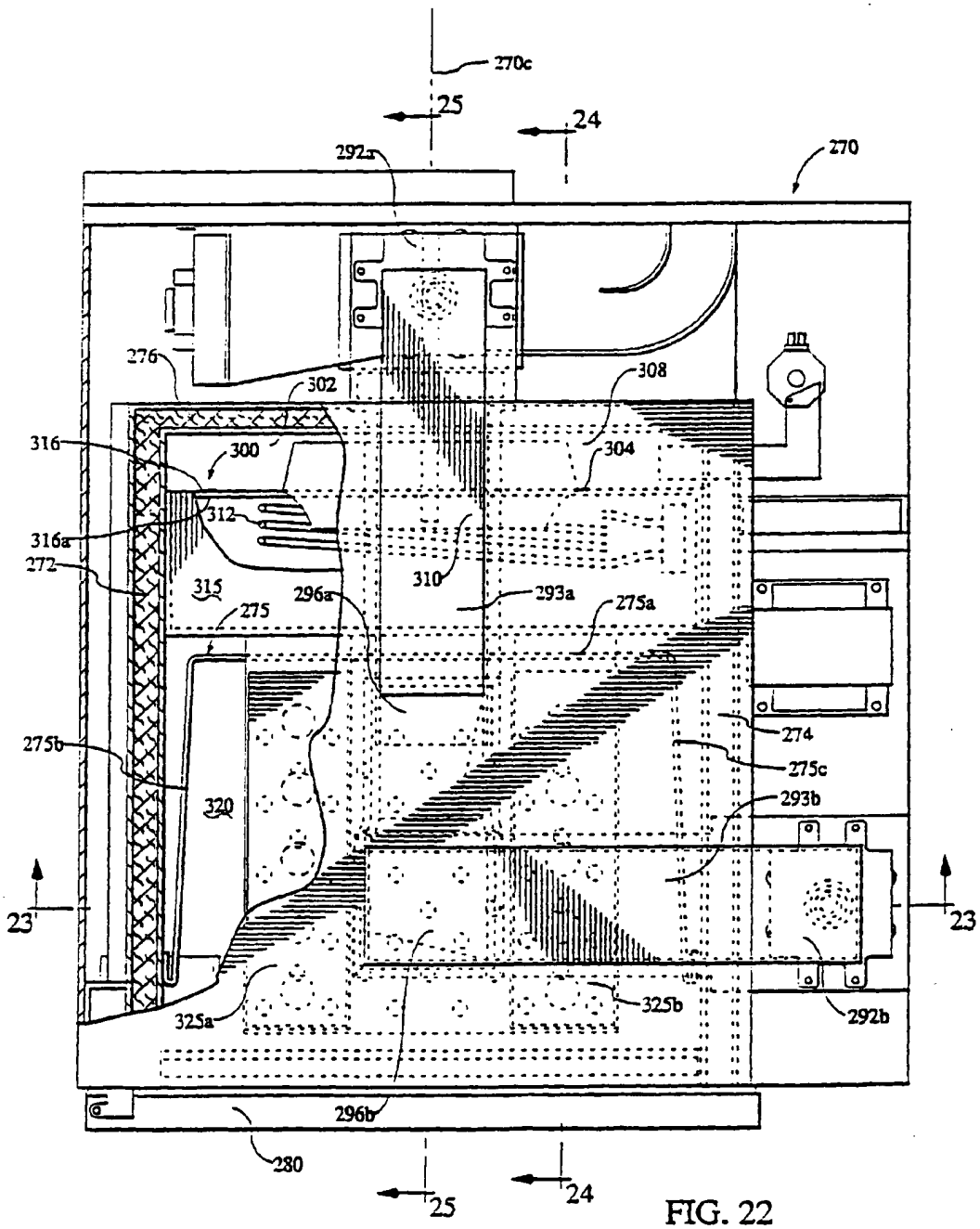
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FIG. 22

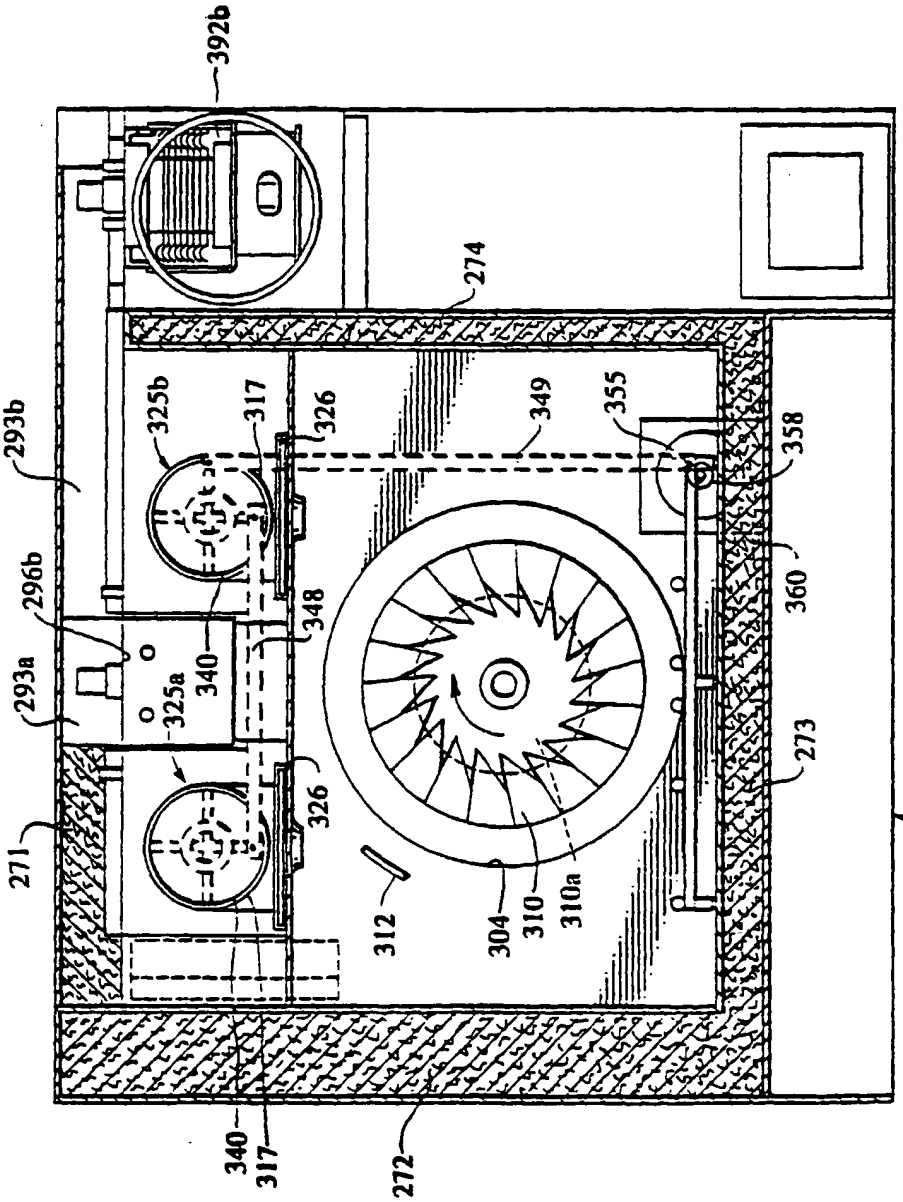
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FIG. 23

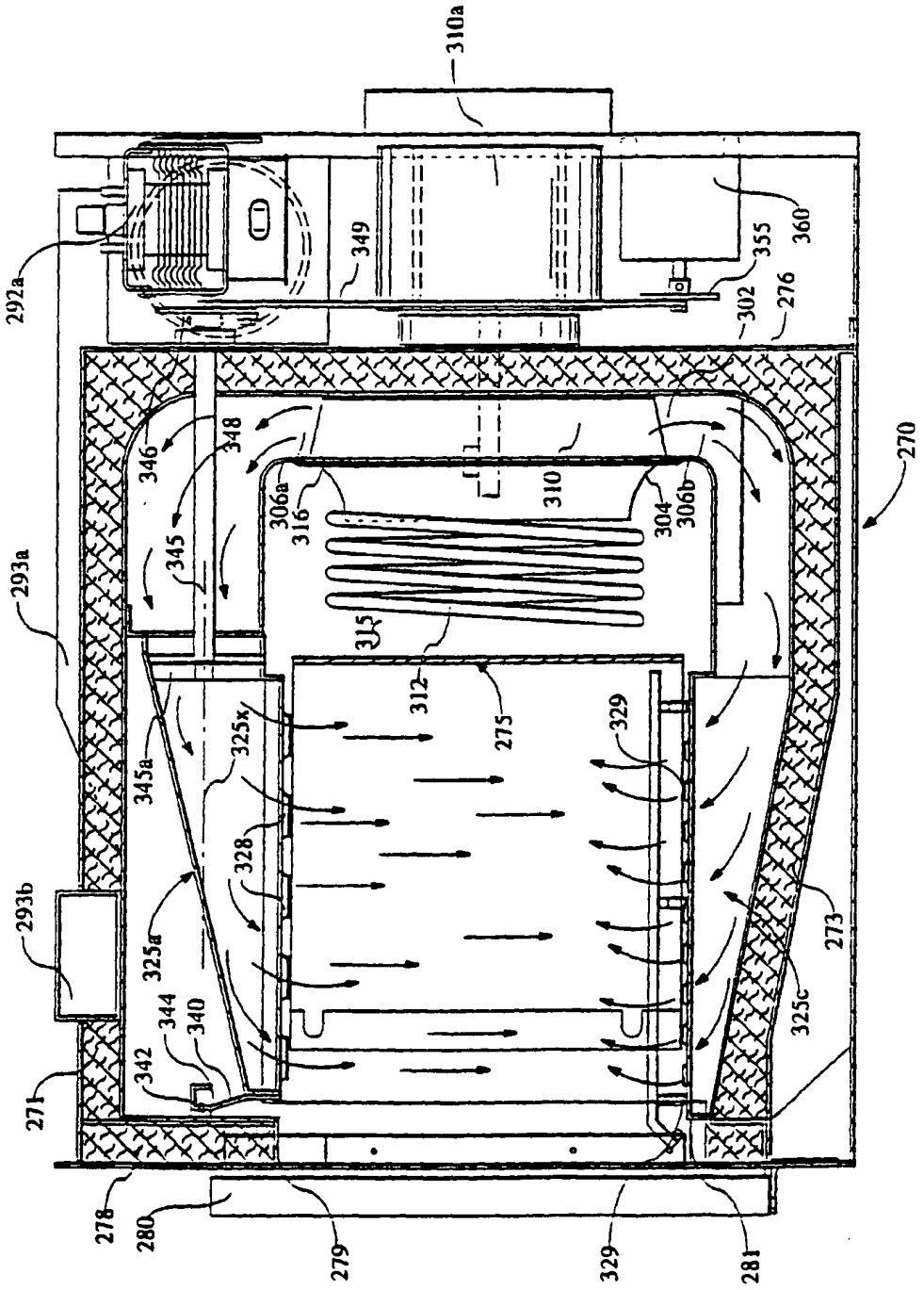
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FIG. 24

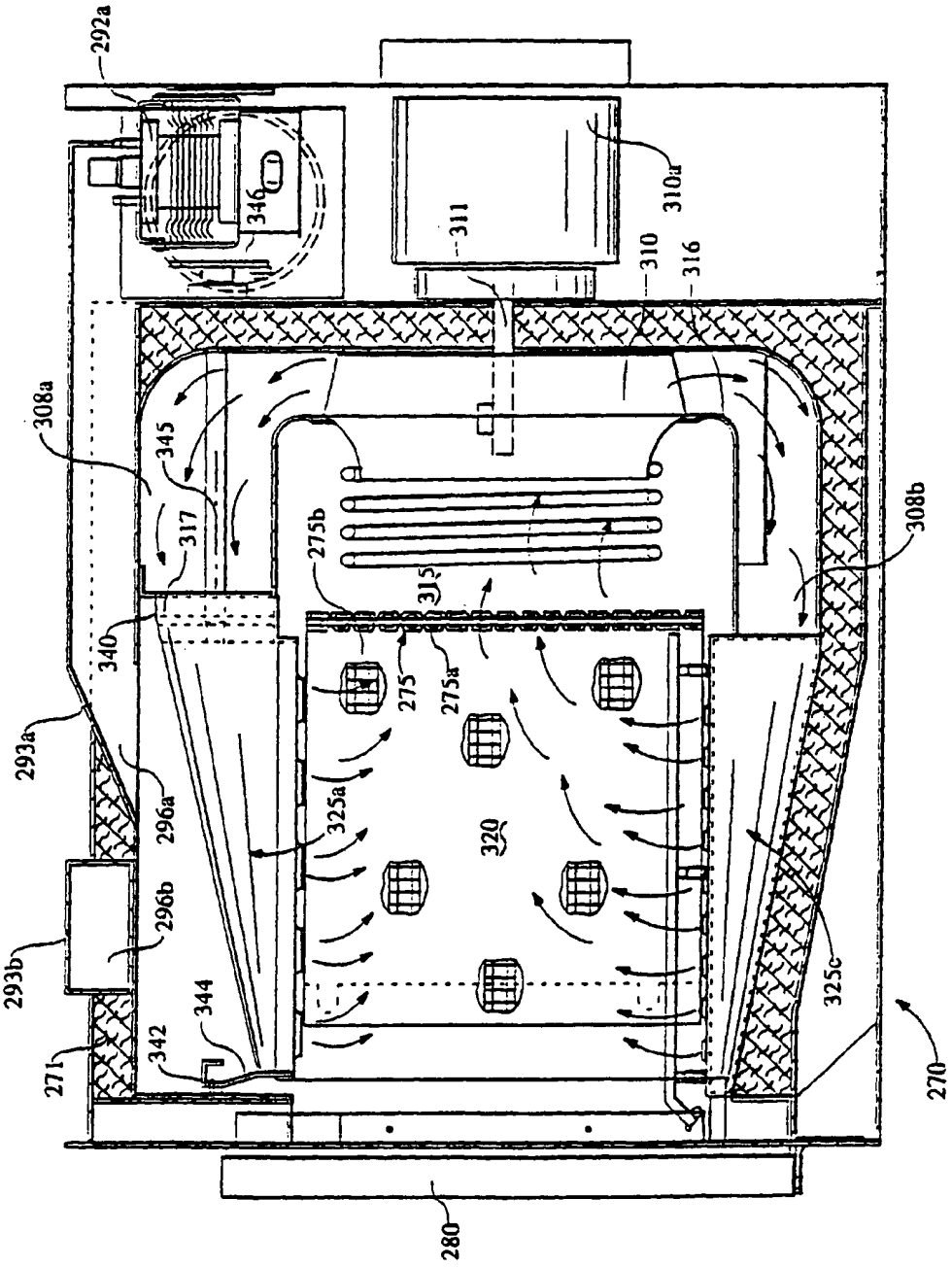
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FIG. 25

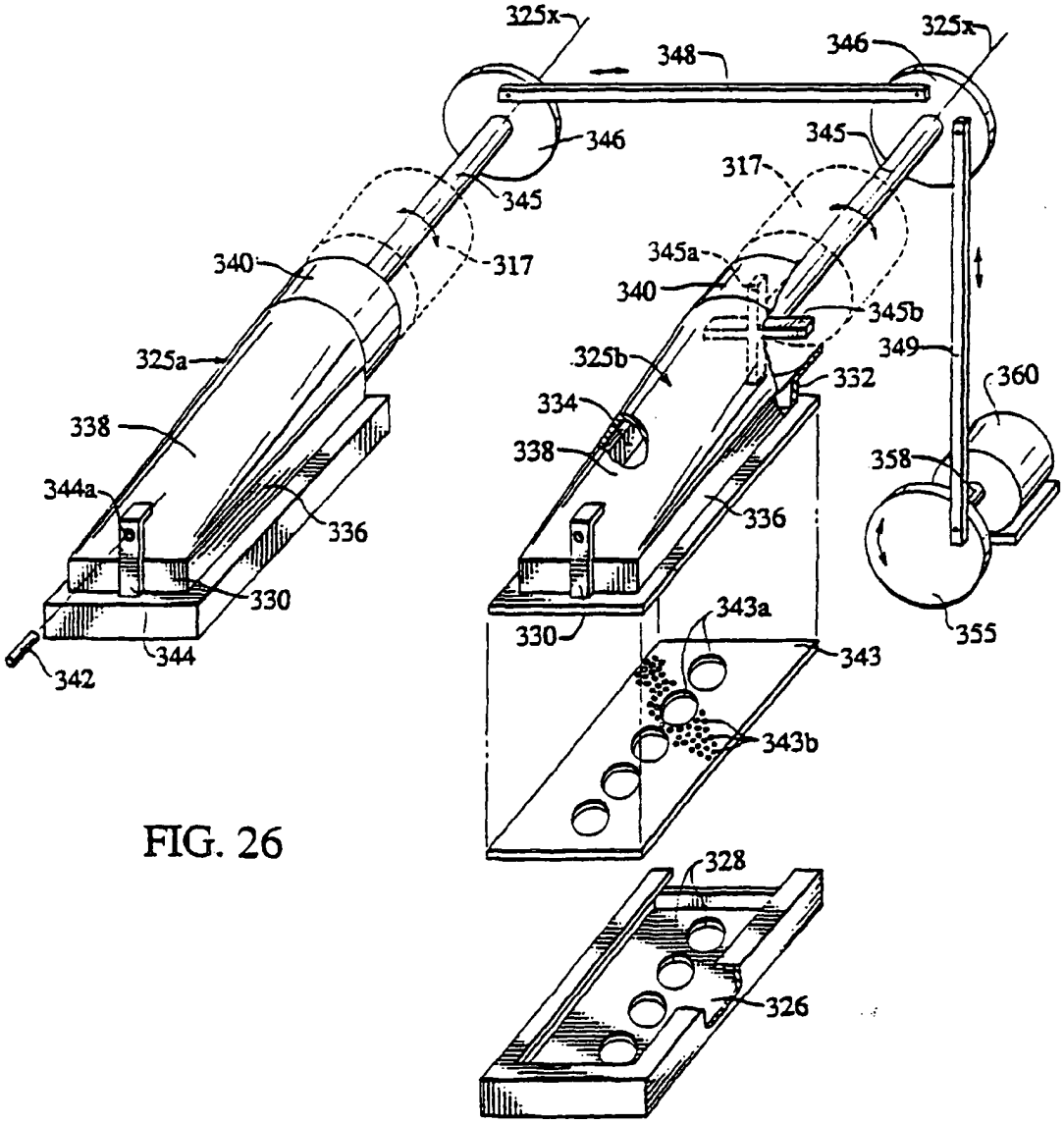
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FIG. 26

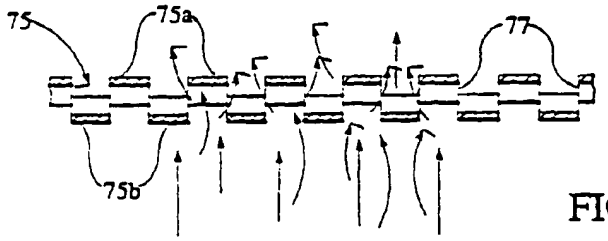

FIG. 29

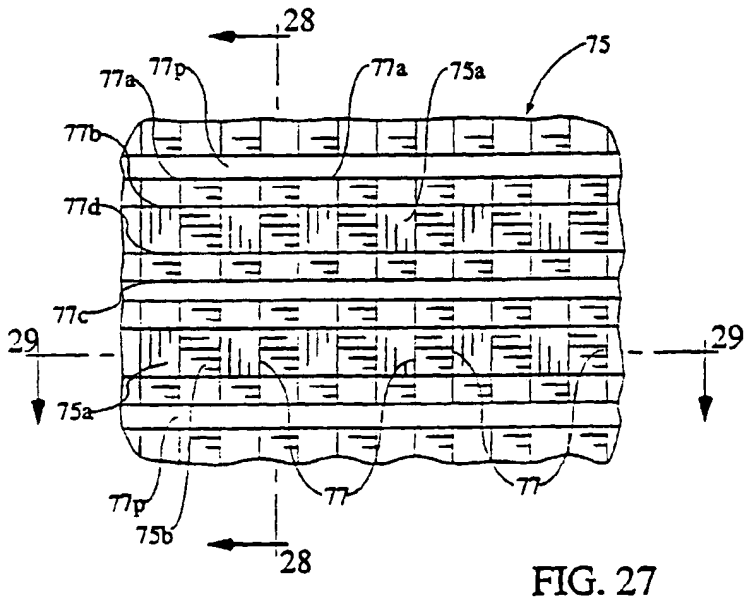

FIG. 27

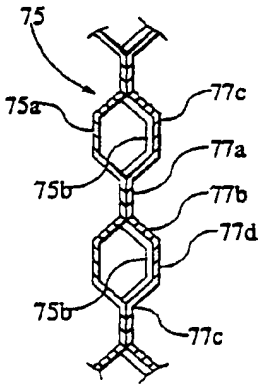

FIG. 28

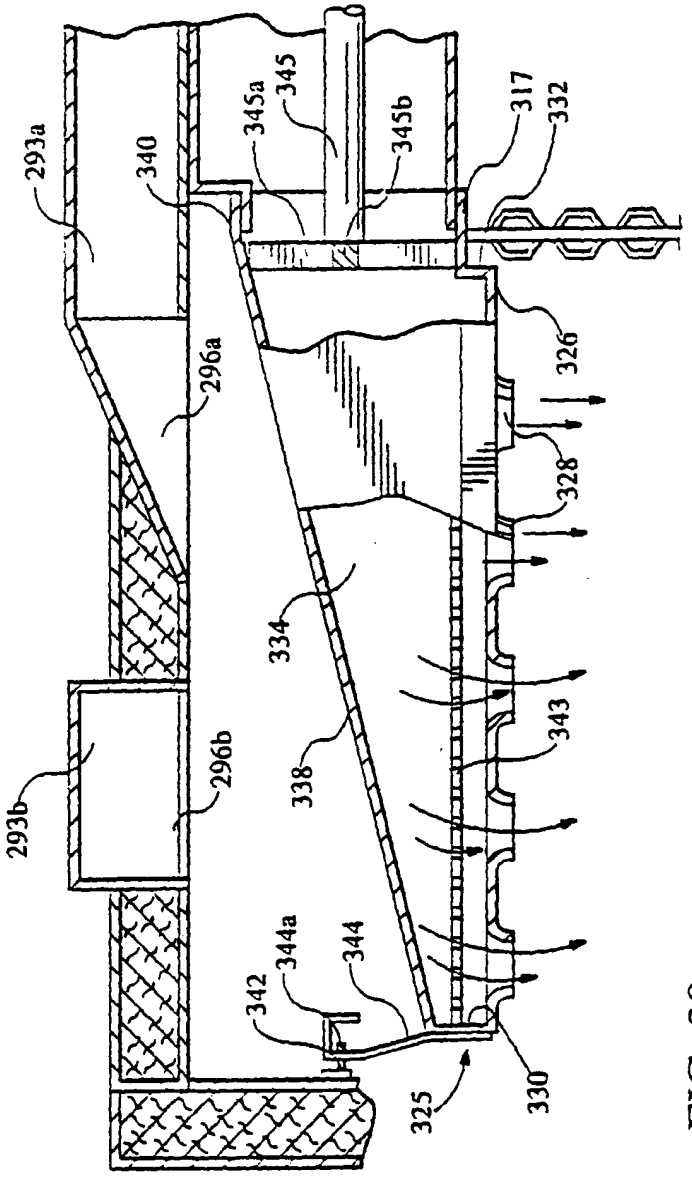
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FIG. 30